3. SAMPLING OBJECTIVES

Data needs and data quality objectives (DQOs) for conducting the proposed sampling in support of the remedial action activities for the individual sites are defined in the following sections. Data needs have been determined through the evaluation of existing data and the projection of data requirements anticipated for the analysis of samples collected during the WAG 5 remedial action. The DQOs have been developed following the process outlined in *Guidance for the Data Quality Objectives Process* (EPA 1994). Due to the fact that the ICDF waste acceptance criteria have not been developed, the DQOs presented in this field sampling plan are, in part, based on the assumption that the ICDF WAC may require further sampling.

3.1 ARA-01

3.1.1 Problem Statement

The first step in the DQO process is to state the problem to be addressed and to put it in programmatic context. There are three basic parts of the problem: soil excavation, waste designation, and interim closure. Soil excavation addresses the field input to guide excavation locations and minimize soil removal. Waste designation addresses the excavated soil. The data from the waste designation will be used for appropriate waste disposal. Interim closure addresses soils remaining in place.

The problem statements associated with the DQO process are:

- **Problem Statement 1**—Given that the soil needs to be excavated and disposed of, collect near-real-time data to guide excavation locations and minimize soil disposal.
- **Problem Statement 2—Waste designation:** Given that the excavated soils are intended for disposal, collect the waste designation data required with the goal of final disposal at the ICDF or other on-Site disposal facility.
- **Problem Statement 3—Interim closure:** Given that the remaining soils are intended for interim closure, collect the characterization data required to meet the cleanup requirements specified in the ROD (DOE ID 2000b).

3.1.2 Decision Identification

The purpose of DQO Step 2 is to define the principal study questions (PSQs) that need to be resolved to address the problem statements identified in DQO Step 1 and the alternative actions that would result from the resolution of the PSQs. The PSQs and the associated alternative actions were combined into decision statements. The PSQs and resultant decision statements are as follows:

- **PSQ #1**—How far and where should the excavation be carried out?
- **DS #1**—Determine the extent of initial excavation, and subsequent hot spot excavations.
- **PSQ #2**—Does excavated soil meet disposal facility WAC?
- **DS #2**—Determine whether excavated soil meets disposal facility WAC, or whether alternate disposal options need to be considered.

- **PSQ #3**—Do soils remaining after remediation meet site remedial action goals?
- **DS #3**—Determine whether soils remaining after remediation meet site remedial action goals as specified in the ROD, and determine whether remediation is complete, as defined in Section 3.1.7.3.

3.1.3 Decision Inputs

The purpose of DQO Step 3 is to identify the type of data needed to resolve each of the decision statements identified in DQO Step 2. This data may already exist or may be derived from computational or surveying/sampling and analysis methods. Analytical performance requirements (e.g., practical quantitation limit [PQL] requirement, precision, and accuracy) are also provided in this step for any new data that need to be collected.

3.1.3.1 Information Required to Resolve Decision Statements. It is necessary to determine the information (data) required to resolve each of the decision statements identified in Section 3.1.2 and identify whether these data already exist. For ARA-01, data for concentrations of arsenic, selenium, and thallium are needed. These data will consist of both field screening and laboratory measurements of contaminants of concern. Data are required to estimate the depth distribution of contaminants to aid in the removal action, and data are required from the excavated soils to demonstrate compliance with the disposal facility WAC. Additionally, data are required of the remaining soils to demonstrate that the remedial action objectives have been achieved.

3.1.3.2 Basis for Setting the Action Level. The action level is the threshold value that provides the criterion for choosing between alternative actions. The basis for setting the action level for decision statements 1 and 3 is the potential for exceeding human health and/or ecological risk-based concentrations in the ARA-01 soils. The basis for setting the action level for decision statement 2 is the disposal facility's WAC. The numerical values of the action levels are defined in DQO Step 5.

3.1.3.3 Computational and Survey/Analytical Methods. Table 3-1 identifies the decision statements where existing data either do not exist or are of insufficient quality to resolve the decision statements. Additionally, Table 3-1 presents computational and/or surveying/sampling methods that could be used to obtain the required data. Field screening samples will be collected for the metal contaminants to estimate the areal and depth distribution of the COCs exceeding the remedial action goals prior to and during the remedial action to support decision statement 1. This data may also be used to support decision statements 2 and 3. A statistically-based number of samples will be collected for decision statement 3 where the 95% upper confidence limit (UCL) of the mean will be compared to the remedial action goals as defined in the ROD (DOE-ID 2000b).

Table 3-1. Information required to resolve the decision statements.

DS #	Required Data	Computational Methods	Survey/Analytical Methods
1, 2	Chemical concentrations, extent of contamination, and WAC acceptability	Correlation of field screening to laboratory measurements	Field screening for determination of metal concentrations in soils.
3	Chemical concentrations in soil	Compare mean (95% UCL) to remedial action goals	Analytical laboratory determination of metal concentrations in soils.

3.1.3.4 ***Analytical Performance Requirements.*** Table 3-2 defines the analytical performance requirements for the data that need to be collected to resolve each of the decision statements. These performance requirements include the PQL, precision, and accuracy requirements for each of the COCs.

3.1.4 Study Boundaries

The primary objective of DQO Step 4 is to identify the population of interest, define the spatial and temporal boundaries that apply to each decision statement, and identify any practical constraints (hindrances or obstacles) that must be taken into consideration in the sampling design. Implementing this step ensures that the sampling design will result in the collection of data that accurately reflect the true condition of the site under investigation.

3.1.4.1 ***Population of Interest.*** Prior to defining the spatial and temporal boundaries of the site under investigation, it is first necessary to clearly define the populations of interest that apply for each decision statement. The populations of interest are as follows:

- DS #1—Contaminated and potentially contaminated soils prior to and during excavation
- DS #2—Contaminated, excavated soils
- DS #3—Remaining soils.

3.1.4.2 ***Geographic Boundaries.*** The geographic boundaries for decision statements 1 and 2 include the lateral boundary depicted in Figure 2-3, approximately 7.6 cm (3 in.) deep across the area with additional volume coming from the removal of hot spots. The geographic boundary for decision statement 3 will be the footprint of the excavation.

3.1.4.3 ***Temporal Boundaries.*** The temporal boundary refers to both the time frame in which each decision statement applies and in which the data should be collected. The time frame for sample collection for decision statement 1 is limited to the duration of the soil excavation. If required, sample collection for decision statement 2 will take place prior to excavation. Decision statement 3 sampling will take place after excavations are complete and field measurements show that contaminant levels are below the remedial action goals.

Table 3-2. Analytical performance requirements.

DS #	Target Analyte List	Survey/Analytical Methods	Preliminary Action Level	PQL	Precision Requirement	Accuracy Requirement
1	Arsenic	XRF	10 mg/kg	0.6 mg/kg	± 30%	70-130
	Selenium	XRF	2.2 mg/kg	0.6 mg/kg		
	Thallium	XRF	4.3 mg/kg	1.7 mg/kg		
2[a]	Arsenic	SW-846	ICDF waste	See	± 30%	70-130
	Selenium	SW-846	acceptance	QAPjP		
	Thallium	SW-846	criteria			
3	Arsenic	SW-846	10 mg/kg	See	± 30%	70-130
	Selenium	SW-846	2.2 mg/kg	QAPjP		
	Thallium	SW-846	4.3 mg/kg			

a. These analyses will be performed only if the ICDF waste acceptance criteria require further analyses. ICDF action levels have not been developed; therefore, they are not listed for DS #2, as they are expected to be significantly higher and do not affect method selection.

3.1.4.4 *Practical Constraints.*

Practical constraints that may impact the data collection effort include physical barriers and potential background interference during field and laboratory measurements.

3.1.5 Decision Rule

The purpose of DQO step 5 is initially to define the statistical parameter of interest (i.e., mean or 95% UCL) that will be used for comparison against the action level. Table 3-3 summarizes the decision rules for the three decision statements provided in Section 3.1.2. These decision rules summarize the attributes the decision-maker needs to know about the sample population and how this knowledge will guide the selection of a course of action to solve the problem.

3.1.6 Decision Error Limits

Since analytical data can only estimate the true condition of the site under investigation, decisions that are made based on measurement data could potentially be in error (i.e., decision error). The primary objective of DQO Step 6 is to determine which decision statements, if any, require a statistically based sample design with tolerable limits on the probability of making a decision error, i.e., deciding that a site is clean when residual contamination in excess of the remedial action goal remains.

Taking into consideration the time frame in which each of the decision statements apply, the qualitative consequences of an inadequate sampling design, and the accessibility of the site if resampling is required, the soils affected by decision statement 3 have been retained for a statistical sampling design. Refer to Section 3.1.7 for details on the selected nonstatistical sampling designs for decision statements 1 and 2.

The two types of decision error that could occur are as follows: treating (managing and disposing of) clean site media as if it were contaminated and treating (managing and disposing of) contaminated site media as if it were clean. The decision error that has the more severe consequence is the latter, since the error could result in human health and/or ecological impacts. Given the two possible errors, null hypotheses were developed for each contaminant of concern stating the opposite of what the investigation hopes to demonstrate. The null hypotheses are stated as follows:

- *The true mean concentration of arsenic exceeds the remedial action goal of 10 mg/kg as stated in the ROD*
- *The true mean concentration of selenium exceeds the remedial action goal of 2.2 mg/kg as stated in the ROD*
- *The true mean concentration of thallium exceeds the remedial action goal of 4.3 mg/kg as stated in the ROD.*

The statistical parameter of interest is the contaminant concentration representing the 95% UCL of the true population mean. The gray region will be taken to be from 80% to 100% of the prescribed remedial action goals.

Table 3-3. Decision rules for the ARA-12 site.

DS #	DR #	Decision Rule
1	1	If any COC concentration exceeds the criteria stated in the ROD, then the soils will be removed; if all COC concentrations are below the remedial action goals, then the verification sampling will be carried out.
2	2	If the COC concentrations exceed the waste acceptance criteria of the disposal facility, then alternative disposal options will be investigated.
3	3	If the concentration representing the 95% UCL on the true population mean for each COC does not exceed the respective remedial action objective as stated in the ROD, then the site will be designated as remediated, and closeout can proceed.

3.1.7 Design Optimization

The objective of DQO Step 7 is to present alternative data collection designs that meet the minimum data quality requirements as specified in DQO Steps 1 through 6. A selection process is then used to identify the most resource-effective, data collection design that satisfies all of the data quality requirements.

As stated in Section 3.1.6, the soils covered under decision statements 1 and 2 will be sampled following a nonstatistical approach. The remaining soils addressed in decision statement 3 will be sampled per a statistical design. The following subsections present the selected field screening, field measurement, and sampling methods for resolving each decision statement, along with a summary of the proposed implementation design.

3.1.7.1 Soil Removal Survey. Field screening will be used to identify hot spots and make decisions in the field as to whether or not further excavation is warranted. Final status of the site will be based on verification sample data.

The initial removal of soil at ARA-01 will involve excavating the top 7.6 cm (3 in.) over the entire pond surface. A minimum of 30 field-screening samples will then be collected from the newly exposed soil in the pond area based on a systematic grid to identify potential hot spots. Based on historical and characterization data, hot spots are anticipated near the pond inlet where contamination could extend to the soil/basalt interface; therefore, biased samples will also be taken adjacent to the pond inlet. All samples will be analyzed for arsenic, selenium, and thallium using an onsite, laboratory-grade, X-ray fluorescence (XRF) spectrometer. Method detection limits of the XRF spectrometer for arsenic, selenium, and thallium are, respectively, 0.6, 0.6, and 1.7 mg/kg. Based on the results of the field screening samples, further excavation will be performed in the identified hot spots until all contamination above the remedial action goals is removed, as demonstrated by field screening measurements, or until the basalt interface is exposed. Final status survey samples will then be collected from the area on a random-start grid to demonstrate that the ARA-01 pond area soils do not contain residual contamination at or above the remedial action goals.

3.1.7.2 Soil Disposal Survey. Currently, the ICDF WAC are under development; however, the Environmental Restoration Disposal Facility (ERDF) at the Hanford site is being used as a model for the ICDF, and process knowledge and historical sampling data for the COCs indicate that the excavated soils from the ARA-01 site do not exceed the ERDF WAC; therefore, they should not exceed the ICDF WAC.

A nonstatistical survey will be performed on all of the excavated soils. Each waste container of soil will be screened for gamma activity using handheld sodium iodide detectors or similar instruments. Each waste container will be evaluated against pertinent transportation requirements and the ICDF WAC. As stated previously, it is not anticipated that the radiological levels of the ARA-01 soils will exceed the disposal facility WAC.

3.1.7.3 Statistical Sampling Design for Soils. After field screening samples indicate that COC concentrations are below the remedial action goals, the statistically based sampling design will be implemented. Initially, 30 data points from the field screening for each of the measured COCs will be randomly selected, and population variances (σ^2) of the COCs will be estimated. The largest variance estimate will then be used to calculate the number of verification samples needed. If the data are normally distributed and are not correlated, the null hypotheses will be tested by comparing the 95% UCL for each COC to the remedial action goals. Normality of the data will be tested graphically and through use of the Shapiro-Wilkes statistic. If data are not normally distributed, then an appropriate transform (i.e., log-normal transform) will be implemented. The 95% UCL is given by the following equation: $UCL = \bar{x} + \frac{(t \cdot s)}{\sqrt{n}}$ where $\bar{x}$ is the population mean, t is obtained from statistical tables, s is the standard deviation, and n is the number of samples. It is important to note that the t-value is based on the degrees of freedom or the number of measurements/samples above the instrument detection limit, minus one. Any measurements that are identified as "less-than-detectable" will not be considered in the UCL. However, when calculating the sample population mean, "less-than-detectable" values will be taken as one-half the reported instrument detection limit. The following equation may be used to calculate the minimum number of verification samples (EPA 1994):

$$n_d = \sigma^2 \left\{ \frac{z_{1-\beta} + z_{1-\alpha}}{C_s - \mu_1} \right\}^2 + \frac{1}{2} \left(z_{1-\alpha} \right)^2 \tag{3-1}$$

where

n_d	=	number of samples
σ^2	=	sample variance
$z_{1-\beta}$	=	critical value for a false negative
$z_{1-\alpha}$	=	critical value for a false positive
C_s	=	remedial action goal
μ_1	=	mean concentration (lower bound of the gray region) where the site should be declared clean.

If the calculated number of samples is less than 10, then 10 samples will be collected. If the calculated number of samples is greater or equal to 10, then the calculated number of samples will be collected. The locations for the closeout samples will be randomly determined from the 30 field measurement locations. After collection and analysis, the 95% UCL of the COCs will be compared to the appropriate ROD cleanup goals for soils.

As noted above, the selected design was based on the error tolerances, as discussed in Section 3.1.6, and the needed comparability to other similar remediation sites. The parameters of the selected statistical design for soils that provide the most resource-effective data collection design are summarized as follows:

- Simple random design
- The statistical test of interest is a comparison of the 95% UCL to the remedial action goal
- The false-positive (α) error rate is 5%
- The false negative (β) error rate is 20%
- The lower bound of the gray region is 80% of the corresponding remedial action goal
- The upper bound of the gray region is the remedial action goal for all soils and COCs.

3.2 ARA-12

3.2.1 Problem Statement

The first step in the DQO process is to state the problem to be addressed and to put it in programmatic context. There are three basic parts of the problem: soil excavation, waste designation, and interim closure. Soil excavation addresses the field input to guide excavation locations and minimize soil removal. Waste designation addresses the excavated soil. The data from the waste designation will be used for appropriate waste disposal. Interim closure addresses soils remaining in place.

The problem statements associated with the DQO process are:

- **Problem Statement 1**—Given that the soil needs to be excavated and disposed of, collect real-time data to guide excavation locations and minimize soil disposal.
- **Problem Statement 2—Waste designation:** Given that the excavated soils are intended for disposal, collect the waste designation data required with the goal of final disposal at the ICDF or other on-Site disposal facility.
- **Problem Statement 3—Interim closure:** Given that the remaining soils are intended for interim closure, collect the characterization data required to meet the cleanup requirements specified in the ROD (DOE ID 10700, 2000).

3.2.2 Decision Identification

The purpose of DQO Step 2 is to define the PSQs that need to be resolved to address the problem statements identified in DQO Step 1 and the alternative actions that would result from the resolution of the PSQs. The PSQs and the associated alternative actions were combined into decision statements. The PSQs and resultant decision statements are as follows:

- **PSQ #1**—How far and where should the excavation be carried out?
- **DS #1**—Determine the extent of initial excavation, and subsequent hot spot excavations
- **PSQ #2**—Does excavated soil meet disposal facility WAC?
- **DS #2**—Determine whether excavated soil meets disposal facility WAC, or whether alternate disposal options need to be considered.
- **PSQ #3**—Do soils remaining after remediation meet site remedial action goals?

- **DS #3**—Determine whether soils remaining after remediation meet site remedial action goals as specified in the ROD, and determine whether remediation is complete, as defined in Section 3.2.7.3.

3.2.3 Decision Inputs

The purpose of DQO Step 3 is to identify the type of data needed to resolve each of the decision statements identified in DQO Step 2. This data may already exist or may be derived from computational or surveying/sampling and analysis methods. Analytical performance requirements (e.g., PQL requirement, precision, and accuracy) are also provided in this step for any new data that need to be collected.

3.2.3.1 Information Required to Resolve Decision Statements. It is necessary to determine the information (data) required to resolve each of the decision statements identified in Section 3.2.2 and identify whether these data already exist. For ARA-12, data for concentrations of Ag-108m, copper, mercury, and selenium are needed. These data will consist of both field and laboratory measurements of contaminants. Data are required to estimate the depth distribution of contaminants to aid in the removal action, and data are required from the excavated soils to demonstrate compliance with the disposal facility WAC. Additionally, data are required of the remaining soils to demonstrate that the remedial action objectives have been achieved.

3.2.3.2 Basis for Setting the Action Level. The action level is the threshold value that provides the criterion for choosing between alternative actions. The basis for setting the action level for decision statements 1 and 3 is the potential for exceeding human health and/or ecological risk-based concentrations in the ARA-12 soils. The basis for setting the action level for decision statement 2 is the disposal facility WAC. The numerical values of the action levels are defined in DQO Step 5.

3.2.3.3 Computational and Survey/Analytical Methods. Table 3-4 identifies the decision statements where existing data either do not exist or are of insufficient quality to resolve the decision statements. Additionally, Table 3-4 presents computational and/or surveying/sampling methods that could be used to obtain the required data. Field measurements and field screening samples will be collected for radiological and chemical contaminants, respectively, to estimate the areal and depth distribution of the COCs exceeding the remedial action goals prior to and during the remedial action to support decision statement 1. This data may also be used to support decision statements 2 and 3. A statistically-based number of samples will be collected for decision statement 3 where the 95% UCL of the mean will be compared to the remedial action goals as defined in the ROD (DOE-ID 2000b).

Table 3-4. Information required to resolve the decision statements.

DS #	Required Data	Computational Methods	Survey/Analytical Methods
1, 2	Radiochemical and chemical concentrations, extent of contamination, and WAC acceptability	Correlation of field measurements to laboratory measurements	Field and laboratory determination of radionuclide and chemical concentrations in soils.
3	Radiochemical and chemical concentrations in soil	Compare mean (95% UCL) to remedial action goals	Field measurements and analytical laboratory determination of radionuclide concentrations in soils and analytical laboratory determination of chemical concentrations in soils.

3.2.3.4 Analytical Performance Requirements. Table 3-5 defines the analytical performance requirements for the data that need to be collected to resolve each of the decision statements. These performance requirements include the PQL, precision, and accuracy requirements for each of the COCs.

3.2.4 Study Boundaries

The primary objective of DQO Step 4 is to identify the population of interest, define the spatial and temporal boundaries that apply to each decision statement, and identify any practical constraints (hindrances or obstacles) that must be taken into consideration in the sampling design. Implementing this step ensures that the sampling design will result in the collection of data that accurately reflect the true condition of the site under investigation.

3.2.4.1 Population of Interest. Prior to defining the spatial and temporal boundaries of the site under investigation, it is first necessary to clearly define the populations of interest that apply for each decision statement. The populations of interest are as follows:

- DS #1—Contaminated and potentially contaminated soils prior to and during excavation
- DS #2—Contaminated, excavated soils
- DS #3—Remaining soils.

3.2.4.2 Geographic Boundaries. The geographic boundaries for decision statements 1 and 2 include the lateral boundary depicted in Figure 2-6, approximately 7.6 cm (3 in.) deep across the area with additional volume coming from the removal of hot spots. The geographic boundary for decision statement 3 will be the footprint of the excavation.

Table 3-5. Analytical performance requirements.

DS #	Target Analyte List	Survey/Analytical Methods	Preliminary Action Level	PQL	Precision Requirement	Accuracy Requirement
1	Ag-108m	Gamma survey and Gamma Spec.	0.75 pCi/g	0.10 pCi/g	± 30%	70-130
	Copper	XRF	220 mg/kg	0.9 mg/kg		
	Selenium	XRF	2.2 mg/kg	0.6 mg/kg		
2[a]	Ag-108m	Gamma Spec.	ICDF waste acceptance criteria	See QAPjP	± 30%	70-130
	Copper	SW-846				
	Mercury	SW-846				
	Selenium	SW-846				
3	Ag-108m	Gamma Spec.	0.75 pCi/g	See QAPjP	± 30%	70-130
	Copper	SW-846	220 mg/kg			
	Mercury	SW-846	0.5 mg/kg			
	Selenium	SW-846	2.2 mg/kg			

a. These analyses will be performed only if the ICDF waste acceptance criteria require further analyses. ICDF action levels have not been developed; therefore, they are not listed for DS #2, as they are expected to be significantly higher and do not affect method selection.

3.2.4.3 Temporal Boundaries. The temporal boundary refers to both the time frame in which each decision statement applies and in which the data should be collected. The time frame for sample collection for decision statement 1 is limited to the duration of the soil excavation. If required, sample collection for decision statement 2 will take place prior to excavation. Decision statement 3 sampling will take place after excavations are complete and field measurements show that contaminant levels are below the remedial action goals.

3.2.4.4 Practical Constraints. Practical constraints that may impact the data collection effort include physical barriers and potential background interference during field and laboratory measurements.

3.2.5 Decision Rule

The purpose of DQO step 5 is initially to define the statistical parameter of interest (i.e., mean or 95% UCL) that will be used for comparison against the action level. Table 3-6 summarizes the decision rules for the three decision statements provided in Section 3.2.2. These decision rules summarize the attributes the decision-maker needs to know about the sample population and how this knowledge will guide the selection of a course of action to solve the problem.

3.2.6 Decision Error Limits

Since analytical data can only estimate the true condition of the site under investigation, decisions that are made based on measurement data could potentially be in error (i.e., decision error). The primary objective of DQO Step 6 is to determine which decision statements, if any, require a statistically based sample design with tolerable limits on the probability of making a decision error, i.e, deciding that a site is clean when residual contamination in excess of the remedial action goal remains.

Taking into consideration the time frame in which each of the decision statements apply, the qualitative consequences of an inadequate sampling design, and the accessibility of the site if resampling is required, the soils affected by decision statement 3 have been retained for a statistical sampling design. Refer to Section 3.2.7 for details on the selected nonstatistical sampling designs for decision statements 1 and 2.

Table 3-6. Decision rules for the ARA-12 site.

DS #	DR #	Decision Rule
1	1	If any COC concentration exceeds the criteria stated in the ROD, then the soils will be removed; if the all COC concentrations are below the remedial action goals, then the verification sampling will be carried out.
2	2	If the COC concentrations exceed the waste acceptance criteria of the disposal facility, then alternative disposal options will be investigated.
3	3	If the concentration representing the 95% UCL on the true population mean for each COC does not exceed the respective remedial action objective as stated in the ROD, then the site will be designated as remediated, and closeout can proceed.

The two types of decision error that could occur are as follows: treating (managing and disposing of) clean site media as if it were contaminated and treating (managing and disposing of) contaminated site media as if it were clean. The decision error that has the more severe consequence is the latter, since the error could result in human health and/or ecological impacts. Given the two possible errors, null hypotheses were developed stating the opposite of what the investigation hopes to demonstrate. The null hypotheses are stated as follows:

- *The true mean concentration of Ag-108m exceeds the remedial action goal of 0.75 pCi/g as stated in the ROD*
- *The true mean concentration of copper exceeds the remedial action goal of 220 mg/kg as stated in the ROD*
- *The true mean concentration of mercury exceeds the remedial action goal of 0.5 mg/kg as stated in the ROD*
- *The true mean concentration of selenium exceeds the remedial action goal of 2.2 mg/kg as stated in the ROD.*

The statistical parameter of interest is the contaminant concentration representing the 95% UCL of the true population mean. The gray region will be taken to be from 80% to 100% of the prescribed remedial action goals.

3.2.7 Design Optimization

The objective of DQO Step 7 is to present alternative data collection designs that meet the minimum data quality requirements as specified in DQO Steps 1 through 6. A selection process is then used to identify the most resource-effective, data collection design that satisfies all of the data quality requirements.

As stated in Section 3.2.6, the soils covered under decision statements 1 and 2 will be sampled/surveyed following a nonstatistical approach. The remaining soils addressed in decision statement 3 will be sampled per a statistical design. The following subsections present the selected field screening, field measurement, and sampling methods for resolving each decision statement, along with a summary of the proposed implementation design.

3.2.7.1 Soil Removal Survey. Field screening will be used to identify hot spots and make decisions in the field as to whether or not further excavation is warranted. Final status of the site will be based on verification sample data. In situ gamma spectroscopy field measurements for Ag-108m will also be used to support the final status decision for ARA-12.

The initial removal of soil at ARA-12 will involve excavating the top 7.6 cm (3 in.) over the entire area defined in Figure 2-6. An additional 7.6 cm (3 in.) will be removed from the hot spot in the northeastern portion of the pond, an area roughly 6 × 20 m (20 × 65 ft). Field screening methods will then be used to identify any remaining hot spots. The excavated area will be surveyed with the ORTEC ISO-CART or similar system to identify Ag-108m hot spots that exceed the 0.75 pCi/g remedial action goal. A systematic grid will be generated, and all locations will be measured with the ISO-CART. The grid will be constructed with 12 m grid spacing (6m radius). This will allow for overlap in the measurements, and provide 100% coverage of the area to ensure that no hot spots above the remedial action goal are missed. Additionally, a field screening composite sample will be collected at a minimum of 30 grid locations and analyzed for copper and selenium using the laboratory XRF spectrometer. Based on the results of the radiological measurements and metals field screening, excavation will be performed in the identified hot spots until contamination above the remedial action goals is removed, as demonstrated by field screening measurements, or until the basalt interface is exposed. Verification sampling will then be conducted for final site closure, and will provide the final verification as described under statistical design below.

3.2.7.2 Soil Disposal Survey. Currently, the ICDF WAC are under development; however, the ERDF at the Hanford site is being used as a model for the ICDF, and process knowledge and historical sampling data for the COCs indicate that the excavated soils from the ARA-12 site do not exceed the ERDF WAC; therefore, they should not exceed the ICDF WAC.

A nonstatistical survey will be performed on all of the excavated soils. Each waste container of soil will be screened for gamma activity using handheld sodium iodide detectors or similar instruments. Each waste container will be evaluated against pertinent transportation requirements and the ICDF WAC. As stated previously, it is not anticipated that the radiological levels of the ARA-12 soils will exceed the disposal facility WAC.

3.2.7.3 Statistical Sampling Design for Soils. After field measurements and screening samples indicate that COC concentrations are below the remedial action goals, the statistically based sampling design will be implemented. Initially, 30 data points from the field screening for each of the measured COCs will be randomly selected, and population variances (σ^2) of the COCs will be estimated. The largest variance estimate will then be used to calculate the number of verification samples needed. If the data are normally distributed and are not correlated, the null hypotheses will be tested by comparing the 95% UCL for each COC to the remedial action goals. Normality of the data will be tested graphically and through use of the Shapiro-Wilkes statistic. If data are not normally distributed, then an appropriate transform (i.e., log-normal transform) will be implemented. The 95% UCL is given by the following equation: $UCL = \bar{x} + \frac{(t \cdot s)}{\sqrt{n}}$ where $\bar{x}$ is the population mean, t is obtained from statistical tables, s is the standard deviation, and n is the number of samples. It is important to note that the t-value is based on the degrees of freedom or the number of measurements/samples above the instrument detection limit, minus one. Any measurements that are identified as "less-than-detectable" will not be considered in the UCL. However, when calculating the sample population mean, "less-than-detectable" values will be taken as one-half the reported instrument detection limit. The following equation may be used to calculate the minimum number of verification samples (EPA 1994):

$$n_d = \sigma^2 \left\{ \frac{z_{1-\beta} + z_{1-\alpha}}{C_s - \mu_1} \right\}^2 + \frac{1}{2}(z_{1-\alpha})^2 \tag{3-2}$$

where

n_d	=	number of samples
σ^2	=	sample variance
$z_{1-\beta}$	=	critical value for a false negative
$z_{1-\alpha}$	=	critical value for a false positive
C_s	=	remedial action goal
μ_1	=	mean concentration (lower bound of the gray region) where the site should be declared clean.

If the calculated number of samples is less than 10, then 10 samples will be collected. If the calculated number of samples is greater or equal to 10, then the calculated number of samples will be collected. The locations for the closeout samples will be randomly determined from the 30 field measurement locations. After collection and analysis, the 95% UCL of the COCs will be compared to the appropriate ROD cleanup goals for soils.

As noted above, the selected design was based on the error tolerances, as discussed in Section 3.2.6, and the needed comparability to other similar remediation sites. The parameters of the selected statistical design for soils that provide the most resource-effective data collection design are summarized as follows:

- Simple random design
- The statistical test of interest is a comparison of the 95% UCL to the remedial action goal
- The false-positive (α) error rate is 5%
- The false negative (β) error rate is 20%
- The lower bound of the gray region is 80% of the corresponding remedial action goal
- The upper bound of the gray region is the remedial action goal for all soils and COCs.

Following the collection of the laboratory analytical data, a linear regression analysis of the field measurement data versus the laboratory gamma spectrometric data will be performed to determine how closely the sets of data are correlated. Linear regression analysis methodology is outlined in *Modeling Patterns in Data Using Linear and Related Models* (INEEL 1996b) and treated in many statistics books. Provided that the field screening systems have acceptable errors, the field screening systems will be used to determine whether site-specific remediation goals have been achieved.

3.3 ARA-23

3.3.1 Problem Statement

The first step in the DQO process is simply to state the problem to be addressed and to put it in programmatic context. There are three basic parts of the problem: soil excavation, waste designation, and interim closure. Soil excavation addresses the field input to guide excavation locations and minimize soil removal. Waste designation addresses the excavated soil. The data from the waste designation will be used for appropriate waste disposal. Interim closure addresses soils remaining in place.

The problem statements associated with the DQO process are:

- **Problem Statement 1**—Given that the soil needs to be excavated and disposed of, collect real-time data to guide excavation locations and minimize soil disposal.
- **Problem Statement 2—Waste designation:** Given that the excavated soils are intended for disposal, collect the waste designation data required with the goal of final disposal at the ICDF or other on-Site disposal facility.

- **Problem Statement 3—Interim closure:** Given that the remaining soils are intended for interim closure, collect the characterization data required to meet the cleanup requirements specified in the ROD (DOE ID 2000, DOE-ID 1996).

3.3.2 Decision Identification

The purpose of DQO Step 2 is to define the PSQs that need to be resolved to address the problem statements identified in DQO Step 1 and the alternative actions that would result from the resolution of the PSQs. The PSQs and the associated alternative actions were combined into decision statements. The PSQs and resultant decision statements are as follows:

- **PSQ #1**—How far and where should the excavation be carried out?
- **DS #1**—Determine the extent of initial excavation, and subsequent hot spot excavations
- **PSQ #2**—Does excavated soil meet disposal facility WAC?
- **DS #2**—Determine whether excavated soil meets disposal facility WAC, or whether alternate disposal options need to be considered.
- **PSQ #3**—Do soils remaining after remediation meet site remedial action goals?
- **DS #3**—Determine whether soils remaining after remediation meet site remedial action goals as specified in the ROD, and determine whether remediation is complete, as defined in Section 3.3.7.3.

3.3.3 Decision Inputs

The purpose of DQO Step 3 is to identify the type of data needed to resolve each of the decision statements identified in DQO Step 2. This data may already exist or may be derived from computational or surveying/sampling and analysis methods. Analytical performance requirements (e.g., PQL requirement, precision, and accuracy) are also provided in this step for any new data that need to be collected.

3.3.3.1 Information Required to Resolve Decision Statements. It is necessary to determine the information (data) required to resolve each of the decision statements identified in Section 3.3.2 and identify whether these data already exist. For ARA-23 data for concentrations of Cs-137 are needed. These data will consist of both field and laboratory measurements of contaminants. Data are required to estimate the depth distribution of contaminants to aid in the removal action, and data are required from the excavated soils to demonstrate compliance with the disposal facility WAC. Additionally, data are required of the remaining soils to demonstrate that the remedial action objectives have been achieved.

3.3.3.2 Basis for Setting the Action Level. The action level is the threshold value that provides the criterion for choosing between alternative actions. The basis for setting the action level for decision statements 1 and 3 is the potential for exceeding human health and/or ecological risk-based concentrations in the ARA-23 soils. The basis for setting the action level for decision statement 2 is the disposal facility WAC. The numerical values of the action levels are defined in DQO Step 5.

3.3.3.3 Computational and Survey/Analytical Methods. Table 3-7 identifies the decision statements where existing data either do not exist or are of insufficient quality to resolve the decision statements. Additionally, Table 3-7 presents computational and/or surveying/sampling methods that could be used to obtain the required data. Field measurements will be collected for radiological contaminants to estimate the areal and depth distribution of the Cs-137 exceeding the remedial action goal prior to and during the remedial action to support decision statement 1. This data may also be used to support decision statements 2 and 3. A statistically-based number of samples will be collected for decision statement 3 where the 95% UCL of the mean will be compared to the remedial action goals as defined in the ROD (DOE-ID 2000b).

3.3.3.4 Analytical Performance Requirements. Table 3-8 defines the analytical performance requirements for the data that need to be collected to resolve each of the decision statements. These performance requirements include the PQL, precision, and accuracy requirements for each of the COCs.

3.3.4 Study Boundaries

The primary objective of DQO Step 4 is to identify the population of interest, define the spatial and temporal boundaries that apply to each decision statement, and identify any practical constraints (hindrances or obstacles) that must be taken into consideration in the sampling design. Implementing this step ensures that the sampling design will result in the collection of data that accurately reflect the true condition of the site under investigation.

Table 3-7. Information required to resolve the decision statements.

DS #	Required Data	Computational Methods	Survey/Analytical Methods
1, 2	Radiochemical concentrations, extent of contamination, and WAC acceptability	Correlation of field measurements to laboratory measurements	Field and laboratory determination of radionuclide concentrations in soils.
3	Radiochemical concentrations in soil	Compare mean (95% UCL) to remedial action goals	Field measurements and analytical laboratory determination of radionuclide concentrations in soils.

Table 3-8. Analytical performance requirements.

DS #	Target Analyte List	Survey/Analytical Methods	Preliminary Action Level	PQL	Precision Requirement	Accuracy Requirement
1	Cs-137	Gamma survey and Gamma Spec.	23 pCi/g	1.0 pCi/g	± 30%	70-130
2[a]	Cs-137	Gamma Spec.	ICDF waste acceptance criteria	See QAPjP	± 30%	70-130
3	Cs-137	Gamma survey and Gamma Spec.	23 pCi/g	See QAPjP	± 30%	70-130

a. These analyses will be performed only if the ICDF waste acceptance criteria require further analyses. ICDF action levels are not listed for DS #2, as they are expected to be significantly higher and do not affect method selection.

3.3.4.1 Population of Interest. Prior to defining the spatial and temporal boundaries of the site under investigation, it is first necessary to clearly define the populations of interest that apply for each decision statement. The populations of interest are as follows:

- DS #1—Contaminated and potentially contaminated soils prior to and during excavation
- DS #2—Contaminated, excavated soils
- DS #3—Remaining soils.

3.3.4.2 Geographic Boundaries. The geographic boundaries for decision statements 1 and 2 include the lateral boundary depicted in Figure 2-5, ranging from 7.6–15 cm (3–6 in.) deep across the area with additional volume coming from the removal of hot spots. The geographic boundary for decision statement 3 will be the footprint of the excavation.

3.3.4.3 Temporal Boundaries. The temporal boundary refers to both the time frame in which each decision statement applies and in which the data should be collected. The time frame for sample collection for decision statement 1 is limited to the duration of the soil excavation. If required, sample collection for decision statement 2 will take place prior to excavation. Decision statement 3 sampling will take place after excavations are complete and field measurements show that contaminant levels are below the remedial action goals.

3.3.4.4 Practical Constraints. Practical constraints that may impact the data collection effort include physical barriers and potential background interference during field and laboratory measurements.

3.3.5 Decision Rule

The purpose of DQO step 5 is initially to define the statistical parameter of interest (i.e., mean or 95% UCL) that will be used for comparison against the action level. Table 3-9 summarizes the decision rules for the three decision statements provided in Section 3.3.2. These decision rules summarize the attributes the decision-maker needs to know about the sample population and how this knowledge will guide the selection of a course of action to solve the problem.

3.3.6 Decision Error Limits

Since analytical data can only estimate the true condition of the site under investigation, decisions that are made based on measurement data could potentially be in error (i.e., decision error). The primary objective of DQO Step 6 is to determine which decision statements, if any, require a statistically based sample design, with tolerable limits on the probability of making a decision error, i.e., deciding that a site is clean when residual contamination in excess of the remedial action goal remains.

Taking into consideration the time frame in which each of the decision statements apply, the qualitative consequences of an inadequate sampling design, and the accessibility of the site if resampling is required, the soils affected by decision statement 3 have been retained for a statistical sampling design. Refer to Section 3.3.7 for details on the selected nonstatistical sampling designs for decision statements 1 and 2.

The two types of decision error that could occur are as follows: treating (managing and disposing of) clean site media as if it were contaminated and treating (managing and disposing of) contaminated site media as if it were clean. The decision error that has the more severe consequence is the latter, since the error could result in human health and/or ecological impacts. Given the two possible errors, a null hypothesis was developed stating the opposite of what the investigation hopes to demonstrate. The null hypothesis is stated as follows:

- *The true mean concentration of Cs-137 exceeds the remedial action goal of 23 pCi/g as stated in the ROD.*

The statistical parameter of interest is the contaminant concentration representing the 95% UCL of the true population mean. The gray region will be taken to be from 80% to 100% of the prescribed remedial action goals.

3.3.7 Design Optimization

The objective of DQO Step 7 is to present alternative data collection designs that meet the minimum data quality requirements as specified in DQO Steps 1 through 6. A selection process is then used to identify the most resource-effective, data collection design that satisfies all of the data quality requirements.

As stated in Section 3.2.6, the soils covered under decision statements 1 and 2 will be sampled/surveyed following a nonstatistical approach. The remaining soils addressed in decision statement 3 will be sampled per a statistical design. The following subsections present the selected field screening, field measurement, and sampling methods for resolving each decision statement, along with a summary of the proposed implementation design.

3.3.7.1 Soil Removal Survey. Field screening will be used to identify hot spots and make decisions in the field as to whether or not further excavation is warranted. Final status of the site will be based on verification sample data. In situ gamma spectroscopy field measurements for Cs-137 will also be used to support the final status decision for ARA-23.

Table 3-9. Decision rules for the ARA-23 site.

DS #	DR #	Decision Rule
1	1	If any COC concentration exceeds the criteria stated in the ROD, then the soils will be removed; if the all COC concentrations are below the remedial action goals, then the verification sampling will be carried out.
2	2	If the COC concentrations exceed the waste acceptance criteria of the disposal facility, then alternative disposal options will be investigated.
3	3	If the concentration representing the 95% UCL on the true population mean for each COC does not exceed the respective remedial action objective as stated in the ROD, then the site will be designated as remediated, and closeout can proceed.

The initial removal of soil at ARA-23 will involve excavating the top 7.6 cm (3 in.) over the entire area defined by the Cs-137 20 pCi/g isopleth in Figure 3-1. Exceptions to this include the SL-1 haul road corridor, the hot spots identified inside the SL-1 burial ground, and inside the fences of the ARA-I and ARA-II facilities. The initial excavation of the SL-1 haul road corridor, SL-1 burial ground hot spots, and the ARA-I and II facilities will remove the top 15 cm (6 in.) of contaminated soil. The excavated areas will then be surveyed with the GPRS to identify remaining hot spots. The hot spots will then be measured with the above ground high-purity germanium (HPGe) spectrometer to positively identify and quantify the remaining Cs-137 contamination. Additionally, estimates of the depth distribution of the remaining contamination will be made from the HPGe measurements. This will assist the field personnel in determining how deep to make the next cut of soil. The removal and field screening process at ARA-23 may require multiple iterations before the remedial action goal of 23 pCi/g is achieved. Use of field screening instrumentation will minimize the number of iterations and increase the efficiency of the removal by positively identifying the depth of residual hot spot contamination and directing the areal and vertical extent of hot spot removal. The number of soil samples collected will be minimized by using GPRS data to support the final status survey due to the vast expanse of the site and the comprehensive nature of the radiological field screening methods. Final status survey measurements and a limited number of verification samples will then be collected from the area on a random grid to demonstrate that ARA-23 area soils do not contain residual contamination at or above the remedial action goal.

3.3.7.2 Soil Disposal Survey. Currently, the ICDF WAC are under development; however, the ERDF at the Hanford site is being used as a model for the ICDF, and process knowledge and historical sampling data for the COCs indicate that the excavated soils from the ARA-23 site do not exceed the ERDF WAC; therefore, they should not exceed the ICDF WAC.

A nonstatistical survey will be performed on all of the excavated soils. Each waste container of soil will be screened for gamma activity using handheld sodium iodide detectors or similar instruments. Each waste container will be evaluated against pertinent transportation requirements and the ICDF WAC. As stated previously, it is not anticipated that the radiological levels of the ARA-23 soils will exceed the disposal facility WAC.

3.3.7.3 Statistical Sampling Design for Soils. After field measurements indicate that Cs-137 concentrations are below the remedial action goals, the statistically based sampling design will be implemented. The ARA-23 area will be divided into 5 separate areas for consideration under the statistical sampling: 1) ARA-I facility, 2) ARA-II facility, 3) haul road and turn around area, 4) equipment washdown area, and 5) windblown area. The area within the boundaries of the SL-1 burial ground will be included with the haul road and turn around areas. Initially, 30 data points from the field measurements will be randomly selected from each area, and population variance (σ^2) of the Cs-137 concentrations will be estimated. The variance estimate will then be used to calculate the number of verification samples needed for each area. If the data are normally distributed and are not correlated, the null hypothesis will be tested by comparing the 95% UCL to the remedial action goal. Normality of the data will be tested graphically and through use of the Shapiro-Wilkes statistic. If data are not normally distributed, then an appropriate transform (i.e., log-normal transform) will be implemented. The 95% UCL is given by the following equation: $UCL = \bar{x} + \frac{(t \cdot s)}{\sqrt{n}}$ where $\bar{x}$ is the population mean, t is obtained from statistical tables, s is the standard deviation, and n is the number of samples. It is important to note that the t-value is based on the degrees of freedom or the number of measurements/samples above the instrument detection limit, minus one. Any measurements that are identified as "less-than-detectable" will not be considered in the UCL. However, when calculating the sample population mean, "less-than-detectable" values will be taken as one-half the reported instrument detection limit. The following equation may be used to calculate the minimum number of verification samples (EPA 1994):

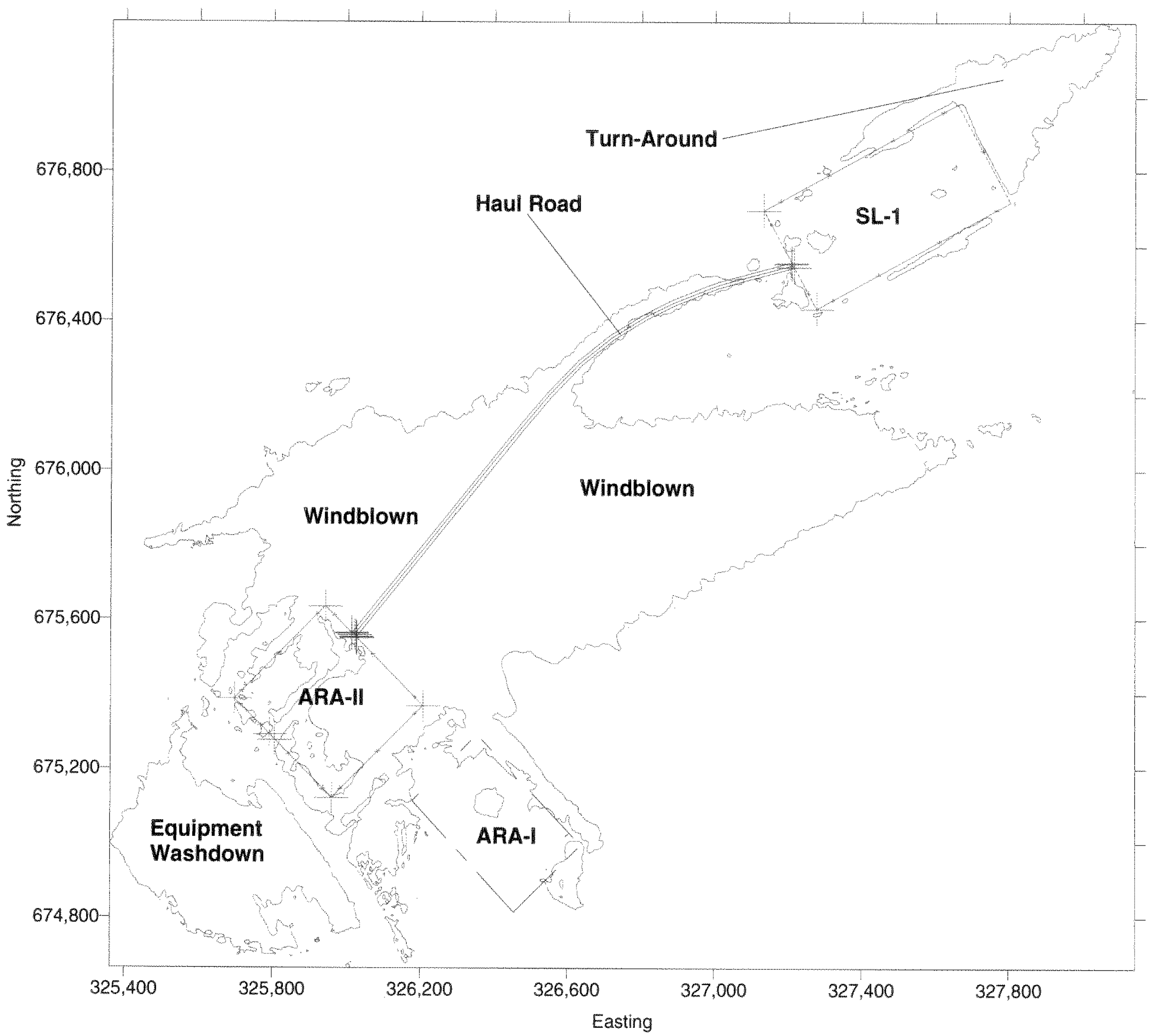

Figure 3-1. Cs-137 contamination at the ARA-23 site exceeding 20 pCi/g.

$$n_d = \sigma^2 \left\{ \frac{z_{1-\beta} + z_{1-\alpha}}{C_s - \mu_1} \right\}^2 + \frac{1}{2}(z_{1-\alpha})^2 \qquad (3\text{-}3)$$

where

n_d	=	number of samples
σ^2	=	sample variance
$z_{1-\beta}$	=	critical value for a false negative
$z_{1-\alpha}$	=	critical value for a false positive
C_s	=	remedial action goal
μ_1	=	mean concentration (lower bound of the gray region) where the site should be declared clean.

If the calculated number of samples is less than 10, then 10 samples will be collected in each of the five areas. If the calculated number of samples is greater or equal to 10, then the calculated number of samples may be collected if the accuracy or precision of the field measurement systems exceed the PQLs listed in Table 3-8. The locations for the verification samples will be randomly determined from the field measurement locations. After collection and analysis, the 95% UCL of the COCs will be compared to the appropriate ROD cleanup goals for soils.

As noted above, the selected design was based on the error tolerances, as discussed in Section 3.3.6, and the needed comparability to other similar remediation sites. The parameters of the selected statistical design for soils that provide the most resource-effective data collection design are summarized as follows:

- Simple random design
- The statistical test of interest is a comparison of the 95% UCL to the remedial action goal
- The false-positive (α) error rate is 5%
- The false negative (β) error rate is 20%
- The lower bound of the gray region is 80% of the corresponding remedial action goal
- The upper bound of the gray region is the remedial action goal for all soils and COCs.

Following the collection of the laboratory analytical data, a linear regression analysis of the field measurement data versus the laboratory gamma spectrometric data will be performed to determine how closely the sets of data are correlated. Linear regression analysis methodology is outlined in *Modeling Patterns in Data Linear and Related Models* (INEEL 1996b) and treated in many statistics books. Provided that the field screening systems have acceptable errors, the field screening systems will be used to determine whether site-specific remediation goals have been achieved.

3.4 Quality Assurance Objectives for Measurement

The QA objectives for measurement will meet or surpass the minimum requirements for data quality indicators established in the QAPjP (DOE-ID 2000a). This reference provides minimum requirements for the following measurement quality indicators: precision, accuracy, representativeness, detection limits, completeness, and comparability. Precision, accuracy, and completeness will be calculated as per the QAPjP (DOE-ID 2000a).

3.4.1 Precision

Precision is a measure of the reproducibility of measurements under a given set of conditions. In the field, precision is affected by sample collection procedures and by the natural heterogeneity encountered in the environment. Overall precision (field and laboratory) can be evaluated by the use of duplicate samples collected in the field. Greater precision is typically required for analytes with very low action levels that are close to background concentrations.

Laboratory precision will be based upon the use of laboratory-generated duplicate samples or matrix spike/matrix spike duplicate samples. Evaluation of laboratory precision will be performed during the method data validation process.

Field precision will be based upon the analysis of collected field duplicate or split samples. For samples collected for laboratory analyses, a field duplicate will be collected at a minimum frequency of 1 in 20 environmental samples.

Precision of field screening samples for metals, and field measurements for radionuclides will be based on the collection of duplicate samples and duplicate measurements. Duplicate samples and measurements will be collected at a frequency of 1 in 20 field screening samples and 1 in 20 field measurements.

3.4.2 Accuracy

Accuracy is a measure of bias in a measurement system. Laboratory accuracy is demonstrated using laboratory control samples, blind quality control (QC) samples, and matrix spikes. Evaluation of laboratory accuracy will be performed during the method data validation process. Sample handling, field contamination, and the sample matrix in the field affect overall accuracy. False positive or high-biased sample results will be assessed by evaluating results from field blanks, trip blanks, and equipment rinsates.

Field accuracy will only be determined for samples collected for laboratory analysis. The accuracy of field instrumentation will be ensured through the use of appropriate calibration procedures and standards.

3.4.3 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which the sampling and analysis data accurately and precisely represent the characteristic of a population parameter being measured at a given sampling point or for a process or environmental condition. Representativeness will be evaluated by determining whether measurements are made and physical samples are collected in such a manner that the resulting data appropriately measure the media and phenomenon measured or studied. The comparison of all field and laboratory analytical data sets obtained throughout this remedial action will be used to ensure representativeness.

3.4.4 Detection Limits

Detection limits for laboratory analyses will meet or exceed the risk-based or decision-based concentrations for the COCs. Detection limits will be as specified in the SMO laboratory Master Task

Agreement statements of work, task order statements of work, and as described in the QAPjP (DOE-ID 2000a).

Detection limits for field instrumentation will also meet or exceed the remedial action goals for the COCs, and are discussed in Section 6.1.1.

3.4.5 Completeness

Completeness is a measure of the quantity of usable data collected during the field sampling activities. The QAPjP (DOE-ID 2000a) requires that an overall completeness goal of 90% be achieved for noncritical samples. If critical parameters or samples are identified, a 100% completeness goal is specified. Critical data points are those sample locations or parameters for which valid data must be obtained in order for the sampling event to be considered complete. For this project, all field screening data will be considered noncritical with a completeness goal of 90%. The laboratory data collected for verification samples will be considered critical with a completeness goal of 100%.

3.4.6 Comparability

Comparability is a qualitative characteristic that refers to the confidence with which one data set can be compared to another. At a minimum, comparable data must be obtained using unbiased sampling designs. If sampling designs are not unbiased, the reasons for selecting another design should be well documented. Data comparability will be assessed through the comparison of all data sets collected during this study for the following parameters:

- Data sets will contain the same variables of interest
- Units will be expressed in common metrics
- Similar analytical procedures and QA will be used to collect data
- Time of measurements of variables will be similar
- Measuring devices will have similar detection limits
- Samples within data sets will be selected in a similar manner
- Number of observations will be of the same order of magnitude.

3.5 Data Validation

Method data validation is the process whereby analytical data are reviewed against set criteria to ensure that the results conform to the requirements of the analytical method and any other specified requirements.

Ten percent of the laboratory-generated analytical data will be validated to Level A per INEEL Technical Procedure (TPR)-79, Levels of Analytical Method Data Validation (INEEL 1995). Level A validation is the most stringent validation level requiring review of all laboratory QA/QC data, as well as raw data generated as a result of the analytical process. All other laboratory data will be validated to Level C. If problems with the data are encountered during Level A validation (data are being rejected), all analytical data of the same type previously validated to Level C will be validated to Level A.

Field-generated data will not be validated. Quality of the field-generated data will be ensured through adherence to established operating procedures and use of equipment calibration as appropriate.

4. SAMPLING DESIGN SUMMARY

The material presented in this section is intended to support the DQOs summarized in Section 3. Field screening measurements in conjunction with verification samples will be collected to support the DQOs presented in Section 3.

4.1 Quality Assurance/Quality Control Samples

The QA samples will be included to satisfy the QA requirements for the field operations as per the QAPjP. The duplicate, blank, and calibration (QA/QC) samples will be analyzed as outlined in Section 3.

4.2 Sampling Locations and Frequency

For the sites being remediated (ARA-01, ARA-12, and ARA-23), sampling is required to confirm that the remediation goals and hence the remedial action objectives have been achieved. The following sections discuss the locations and frequency with which samples will be collected from the individual sites covered under this FSP.

4.2.1 ARA-01

Sampling activities at ARA-01 will include the collection of field screening samples and verification samples that will be sent to an approved analytical laboratory. A minimum of 30 samples will be collected for field screening purposes from the surface of the exposed soils after the first 7.6 cm (3 in.) of contaminated soils have been removed. The sample locations will be selected from a systematic grid within the geographic boundary of the ARA-01 site as shown in Figure 4-1. The field screening samples will be analyzed on-Site using a laboratory-grade XRF spectrometer. Based on the results of the field screening, there are two options for proceeding with the remedial action and field sampling:

- If the field screening analyses show that the samples are below the remedial action goals for all of the COCs (arsenic, selenium, and thallium), then a minimum of 10 verification samples (see Figure 4-1) will be collected and shipped to an approved analytical laboratory for verification analyses.

- If the field screening analyses show that any samples are above the remedial action goals for any of the COCs, additional hot-spot excavation will be conducted in the area where the sample(s) were collected and additional field screening analyses will be performed. This process will be repeated until the field screening results show that the remedial action objectives have been met or until all soil is removed to basalt.

If the mean concentrations from either the initial sampling or the statistical sampling show that the remediation goals have been exceeded, additional excavation and field screening measurements will be required. If this is ever the case, verification sampling will be performed only in the newly excavated area at the same latitude and longitude as the initial verification sample location(s), and the data set will be reevaluated to determine whether or not the remedial action objectives have been met. This will eliminate resampling of the entire ARA-01 site.

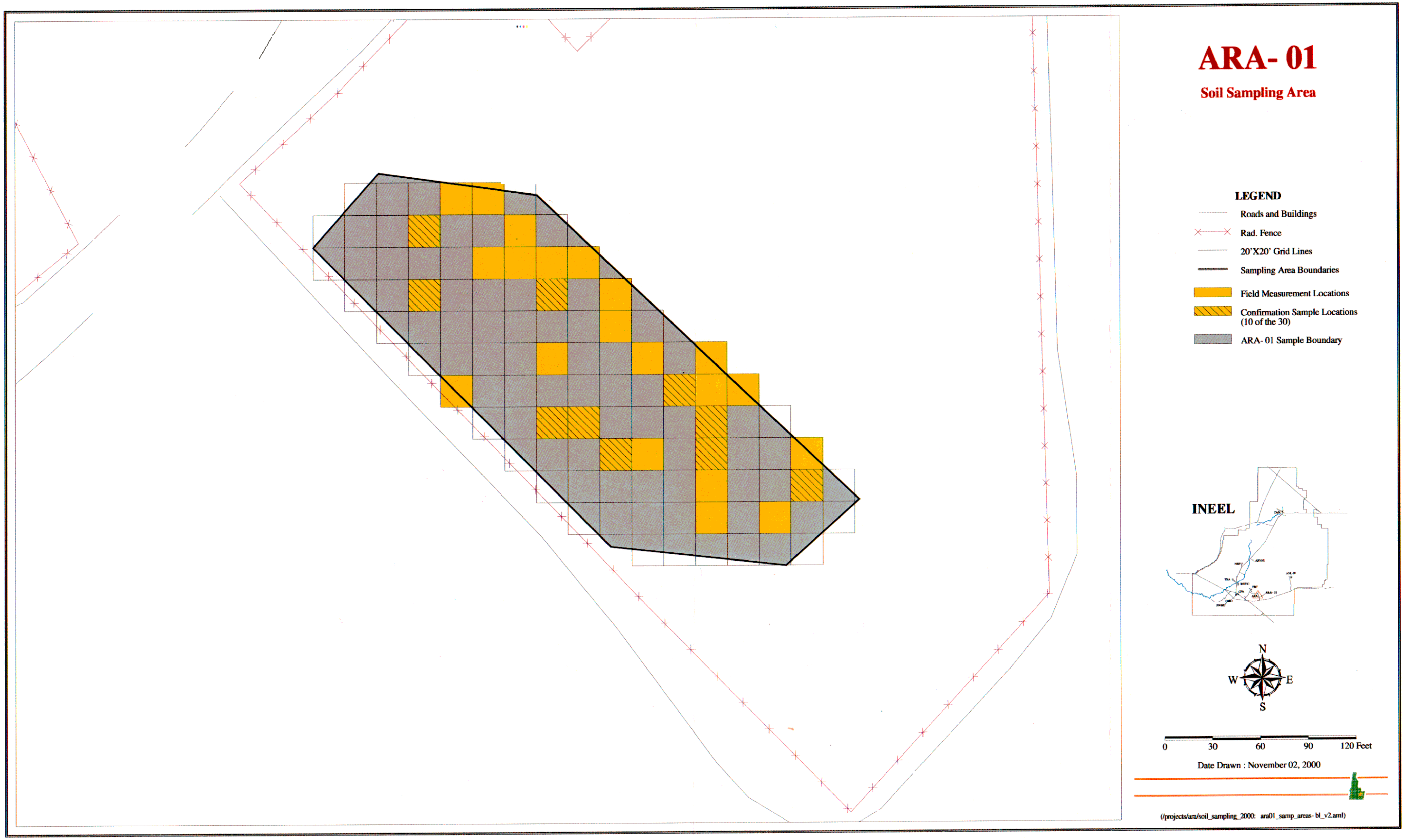

Figure 4-1. ARA- s after first excavatioı

4.2.2 ARA-12

Similar to ARA-01, sampling activities at ARA-12 will include the collection of field screening samples and verification samples; additionally, measurements with the ORTEC ISO-CART, or other comparable system, will be made at the same locations to evaluate the levels of Ag-108m. Field screening samples for copper, mercury and selenium analyses, and in situ measurements for Ag-108m will be made after the initial layer of contaminated soils has been removed as shown in Figure 4-2. The field screening samples will be analyzed on-Site using a laboratory-grade XRF spectrometer. As with the ARA-01 site, continuation of the remedial action process will be based on the field sampling results. If field screening results show that the remedial action objectives have been met for all of the COCs, then verification sampling/measurements will be conducted as detailed below.

For copper, mercury, and selenium, verification sampling will be performed following the same approach as specified for ARA-01. The number of samples collected for copper, mercury, and selenium analyses will be based upon the largest variance as determined from the field screening methods. Analysis of the data will determine whether the remediation goals have been achieved for these metals as stated previously in Section 3.2.

The verification sampling for Ag-108m will be comprised of a combination of 30 field measurements and a minimum of 10 laboratory samples. Field measurements will be performed using either the ORTEC ISO-CART or other comparable system (refer to Section 6.1.2). The laboratory samples will be selected at random from within the geographic boundaries of the ARA-12 site, and are shown in Figure 4-2.

The ORTEC ISO-CART detector will be set upon a stand that maintains a constant detector-to-ground distance of one meter. At this elevation, the germanium spectrometer has a field of view approximately 20 m (66 ft) in diameter. A sodium iodide detector mounted on a medical crutch or similar configuration may also be used to locate "hot-spots" with actual confirmatory measurements performed either with the ISO-CART or other comparable system.

It will be necessary to correlate the Ag-108m screening data to actual laboratory analysis; however, it is important to realize the shortcomings of attempting such a correlation due to sample collection methods. For the field screening methods, a much larger area is analyzed at one time; whereas, with laboratory analytical methods, much greater reliance is placed on the field sampling techniques to ensure that representative samples are obtained. Verification samples will be comprised of 10 subsamples taken from radial distances of 2, 4, and 10 m (6.5, 13, and 33 ft.) from the grid center as detailed in Section 6.1.2. An estimation of the spatial heterogeneity can be obtained from the analysis of both analytical and field duplicate samples. Correlation of field screening data with laboratory data will take this variability into account when making the statistical comparison of the two data sets.

4.2.3 ARA-23

Sampling activities at ARA-23 will include field measurements and the collection of verification samples. As for the Ag-108m verification sampling being performed at ARA-12, verification sampling for Cs-137 at ARA-23 will be comprised of a combination of field screening and laboratory analysis. The field measurements will be performed using the GPRS and the ORTEC ISO-CART, or other comparable system. The ARA-23 area will be divided into 5 separate areas for consideration under the statistical sampling: 1) ARA-I facility, 2) ARA-II facility, 3) haul road and turn around area, 4) equipment washdown area, and 5) windblown area. The area within the boundaries of the SL-1 burial ground will be included with the haul road and turn around areas. The GPRS will be used to identify hot spots and provide semi-quantitative numbers for the Cs-137 concentrations. The ISO-CART will then be used to measure a minimum of 30 locations within each area as shown in Figure 4-3. The field measurement locations will be selected from a systematic grid from within the geographic boundaries of the five areas within ARA-23. The GPRS and ISO-CART systems will provide 100% coverage of the ARA-23 site to ensure that hot spots exceeding 23 pCi/g do not remain.

The verification sampling for Cs-137 will be comprised of a combination of field measurements and 10 laboratory samples from each of the five identified areas within the ARA-23 site. Field measurements will be performed using either the ORTEC ISO-CART or other comparable system (refer to Section 6.1.2). The laboratory samples will be selected at random from within the geographic boundaries of the ARA-23 site.

As for the Ag-108m at ARA-12, a correlation of Cs-137 field screening data to laboratory data will be performed, again taking into account variability due to field sampling techniques when making the comparison of the two data sets.

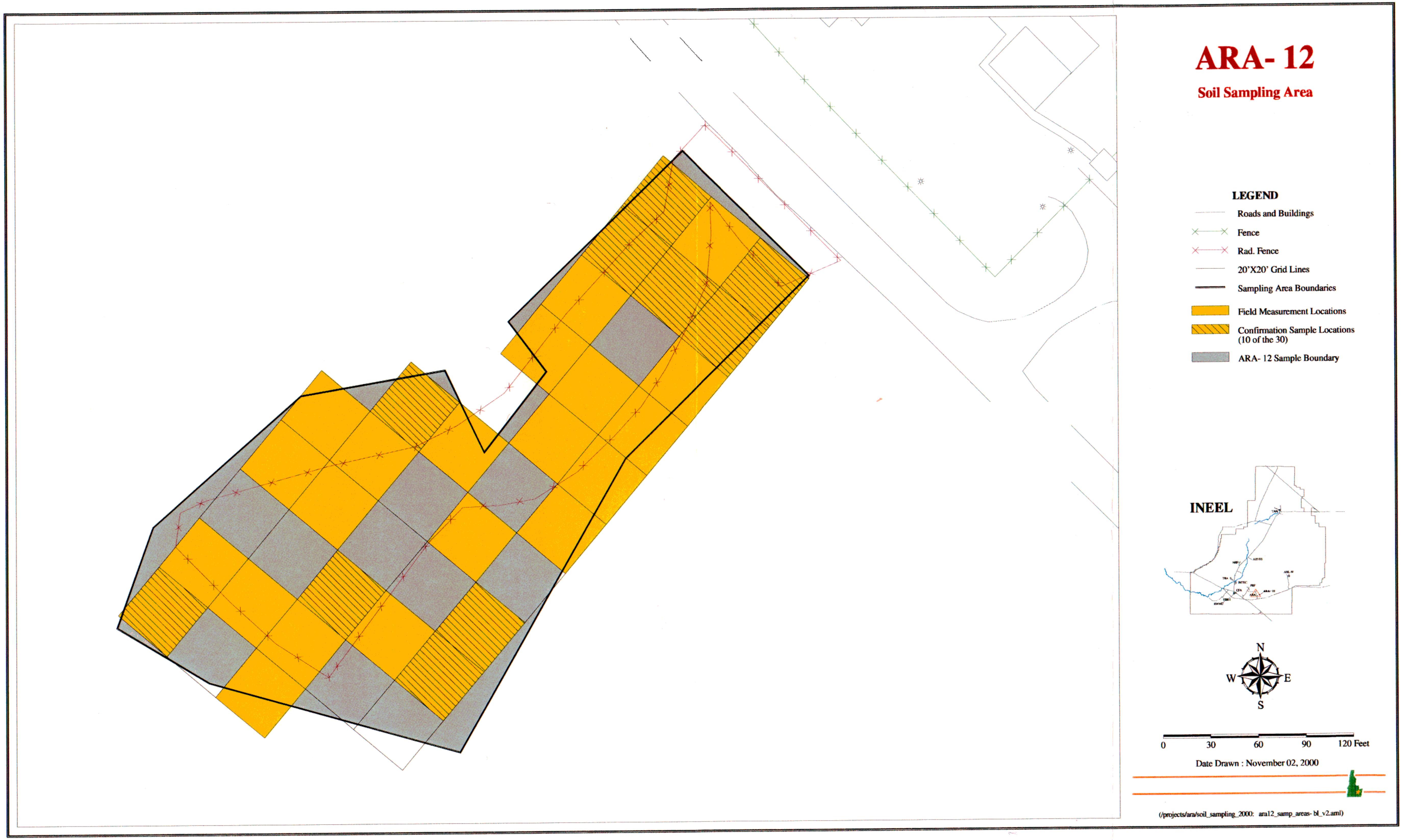

Figure 4-2. ARA-12 field measurement locations after first excavation.

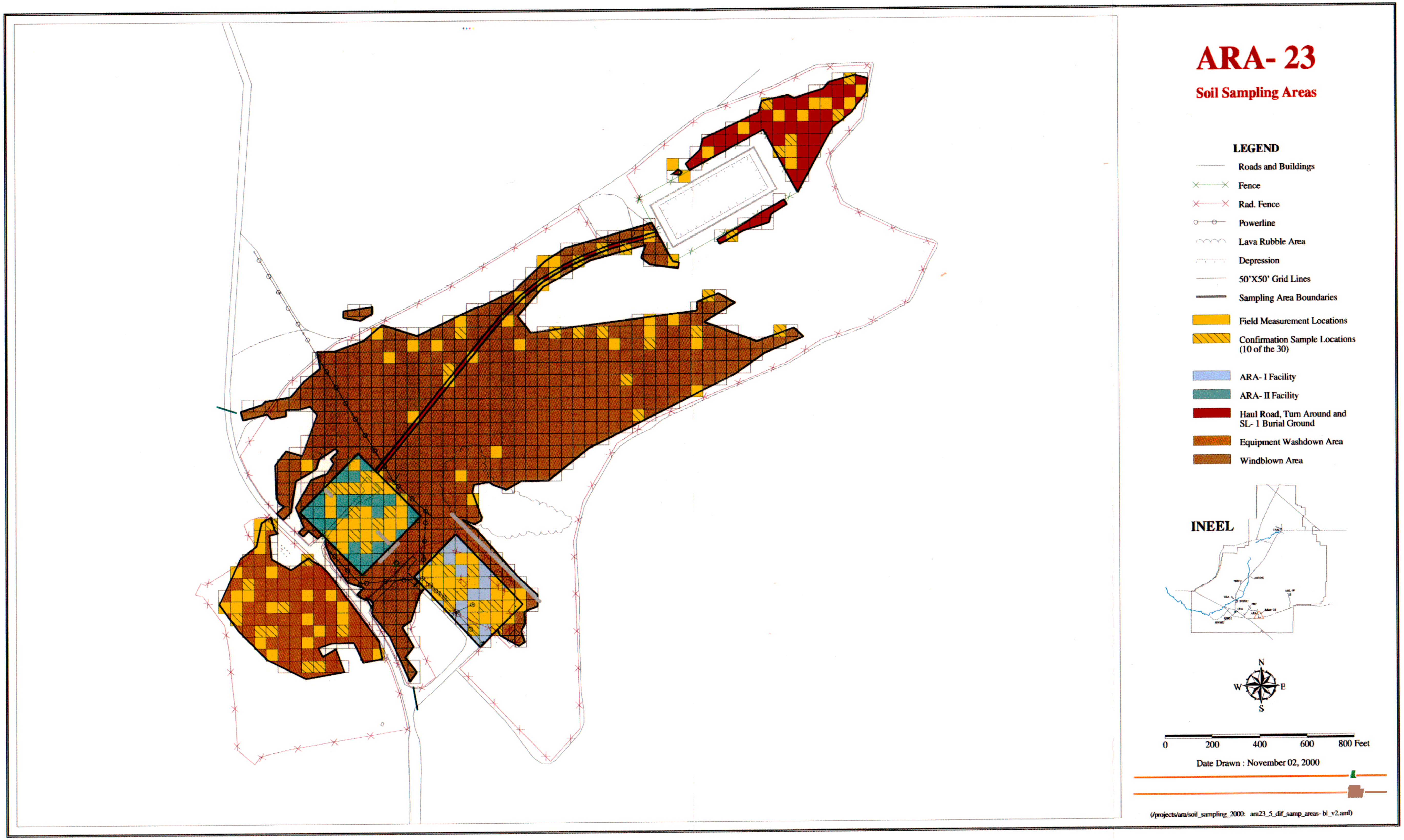

Figure 4-3. ARA-23 field measurement locations after first excavation.

5. SAMPLING DESIGNATION

5.1 Sample Identification Code

A systematic character identification (ID) code will be used to uniquely identify all laboratory samples. Uniqueness is required for maintaining consistency and preventing the same ID code from being assigned to more than one sample.

The first designator of the code, **5**, refers to the sample originating from WAG 5. The second and third designators, **RA**, refer to the sample being collected in support of the remedial action. The next three numbers designate the sequential sample number for the project. A two-character set (i.e., 01, 02) will be used to designate field duplicate samples. The last two characters refer to a particular analysis and bottle type. Refer to the SAP tables in Appendix A for specific bottle code designations.

For example, a soil sample collected in support of confirming the Cs-137 concentrations via gamma spectrometric analysis might be designated as 5RA00101R4 where (from left to right):

- **5** designates the sample as originating from WAG 5
- **RA** designates the sample as being collected in support of the remedial action
- **001** designates the sequential sample number
- **01** designates the type of sample (01 = original, 02 = field duplicate)
- **R4** designates gamma spectrometric analysis.

A SAP table/database will be used to record all pertinent information associated with each sample ID code.

5.2 Sampling and Analysis Plan Table/Database

5.2.1 SAP Table

A SAP table format was developed to simplify the presentation of the sampling scheme for project personnel. The following sections describe the information recorded in the SAP table/database, which is presented in Appendix A.

5.2.2 Sample Description

The sample description fields contain information relating individual sample characteristics.

5.2.2.1 Sampling Activity. The sampling activity field contains the first six characters of the assigned sample number. The sample number in its entirety will be used to link information from other sources (field data, analytical data, etc.) to the information in the SAP table for data reporting, sample tracking, and completeness reporting. The analytical laboratory will also use the sample number to track and report analytical results.

5.2.2.2 *Sample Type.* Data in this field will be selected from the following:

- REG for a regular sample
- QC for a QC sample.

5.2.2.3 *Media.* Data in this field will be selected from the following:

- SOIL for soil samples
- WATER for QA/QC water samples.

5.2.2.4 *Collection Type.* Data in this field will be selected from the following:

- GRAB for grab sample collection
- COMP for composite sample collection
- RNST for rinsate QA/QC samples
- DUP for field duplicate samples
- FBLK for field blank QA/QC samples.

5.2.2.5 *Planned Date.* This date is related to the planned sample collection start date.

5.2.3 Sample Location Fields

This group of fields pinpoints the exact location for the sample in three-dimensional space, starting with the general AREA, narrowing the focus to an exact location geographically, and then specifying the DEPTH in the depth field.

5.2.3.1 *Area.* The AREA field identifies the general sample collection area. This field should contain the standard identifier for the INEEL area being sampled. For this investigation, samples are being collected from ARA-01, ARA-12, and ARA-23; the AREA field identifier will correspond to one of the three sites.

5.2.3.2 *Location.* The LOCATION field may contain geographical coordinates, x-y coordinates, building numbers, or other location identifying details, as well as program specific information such as borehole or well number. Data in this field will normally be subordinated to the AREA. This information is included on the labels generated by the SMO to aid sampling personnel.

5.2.3.3 *Type of Location.* The TYPE OF LOCATION field supplies descriptive information concerning the exact sample location. Information in this field may overlap that in the location field, but it is intended to add detail to the location.

5.2.3.4 *Depth.* The DEPTH of a sample location is the distance in feet from surface level or a range in feet from the surface.

5.2.4 Analysis Types (AT1-AT20)

These fields indicate analysis types (radiological, chemical, hydrological, etc.). Space is provided at the bottom of the form to clearly identify each type. A standard abbreviation should also be provided if possible.

6. SAMPLING PROCEDURES AND EQUIPMENT

The following sections describe the sampling procedures and equipment to be used for the planned sampling and analyses described in this FSP. Prior to the commencement of any sampling activities, a prejob briefing will be held to review the requirements of the FSP and the project HASP and to ensure all supporting documentation has been completed.

6.1 Sampling Requirements

Sampling requirements for Phase II of the WAG 5 remedial action sampling are outlined in the following sections. Table 6-1 provides the requirements for sample containers, preservation methods, sample volumes, and holding times for soil and QA/QC samples. The specific analyses required are provided in Section 3.

6.1.1 Field Measurements

Field measurements and field screening samples will be collected in support of the remedial activities at the ARA-01, ARA-12 and ARA-23 sites. Additionally, field measurements for radiological COCs will be made and used to support the decision that the remedial action objectives have been met for the ARA-12 and ARA-23 sites. The following sections describe the field measurement and field screening equipment and the associated project requirements associated with the measurement systems.

6.1.1.1 GPRS Operations. The INEEL GPRS is a mobile field survey system designed to rapidly characterize the areal extent of gamma-emitting radionuclide contamination of surficial soils. The GPRS consists of two large-area plastic scintillation radiation detectors mounted to the front of an all-terrain vehicle that is equipped with global positioning system navigation instruments. The GPRS integrates the radiological data with the global positioning system data to provide information regarding the spatial distribution of contamination in the form of an area map.

Table 6-1. Specific sample requirements for the WAG 5 Phase II remedial action.

Analytical Parameter	Container		Sample Matrix	Preservative	Analytical Method	Holding Time
	Size	Type				
Radionuclides	16-oz	WM HDPE	Soil	None	Gamma Spectroscopy	6 months
Radionuclides	2-L	HDPE	Water	HNO_3 to pH<2	Gamma Spectroscopy	6 months
Metals	250-mL	WM Glass	Soil	Cool to 4°C	SW-846 6010B/7000A/ 7471A	28 days for Hg, 6 months for all others
Metals	1-L	HDPE	Water	HNO_3 to pH<2	SW-846 6010B/7000A/ 7470A/7471A	28 days for Hg, 6 months for all others

The GPRS will be the primary means of determining whether sufficient layers of soil have been removed from the ARA-12 and ARA-23 sites to meet the remediation goals. Operation of the GPRS will follow the procedures outlined in "Surface Radiation Surveys Using the GPRS" (INEEL 1997b). The unit will be deployed at the contaminated soil sites to obtain surface radiation measurements. Data will be reduced and area maps constructed delineating the hot spots and gamma contamination contours of the individual sites.

6.1.1.2 Gamma Field Screening. Two additional types of portable field instrumentation may be used in measuring gamma emitters. The first type of gamma field screening instrumentation that will be used is a HPGe gamma spectroscopy detector such as the ORTEC ISO-CART or other comparable system. The instrument will be positioned 1 m (3.3 ft) above ground for the initial scanning activity. The resulting field of view at this elevation is a circle with a diameter of 20 m (66 ft). The instrument will be located as described in Section 4 with overlapping zones of influence to ensure the scanning of the entire surface of interest. If gamma radiation is detected, the detector may be lowered in-place, or collimators may be used to narrow the field of view to aid in the identification and delineation of hot spots. Operation of the instrument will follow the procedures outlined in the user's manual for the ISO-CART System (ORTEC 1999) or other appropriate system operating manual.

One of the distinct advantages of in situ measurements relates to the sensor field of view. The field of view may be made quite large through appropriate sensor design, permitting the detector to count photons emitted over an extended area. Thus, even for low radionuclide concentrations, a large number of photo-detector interactions occur and the measurement may be made rapidly. Thusly, it becomes possible to fully map radionuclide concentrations over a large area. By utilizing overlapping fields of view, it is ensured that areas with concentrations exceeding the remedial action goal are not missed. A second advantage is the ability to estimate contaminant depth distribution. Ag-108m emits three gamma-rays at significantly different energies, 433.94 keV, 614.28 keV, and 722.91 keV, and known intensities (approximately 90% for each gamma-ray). An estimation of the depth distribution may be made by calculating the degree of attenuation, taking into consideration detector efficiency, of two of the different gamma-rays, i.e., 433.94 keV and 722.91 keV. Given a source of Ag-108m that is distributed on the surficial soils, the ratio of the peak intensities from the two widely spaced gamma-rays is known; however, if the source is either buried, or distributed, the peak ratio will be measurably different. The difference can be used to calculate an estimated depth of the source. Similar to Ag-108m, the in situ measurement techniques for Cs-137 include methods for addressing the depth distribution of the radionuclide. A K x-ray emitted in the Cs-137 decay chain permits a comparison of attenuation between photons having very different energies. The K x-ray and the 662 keV gamma ray are emitted in known ratios, with the higher energy 662 keV gamma ray having much greater penetrating ability. Therefore, for a deep soil source, virtually none of the lower energy (32 keV) K x-rays would escape the shielding effect of the soil while the gamma rays would still be detected. Conversely, K x-rays and gamma rays are detected in very nearly the proportion they are emitted for a surface source. Therefore, this information can be used to determine during excavation whether additional excavation may be needed to remove a Cs-137 source located beneath the surface.

The secondary scanning equipment will be a portable gamma scintillometer using a sodium iodide (NaI) crystal. The gamma survey will be conducted by sweeping the NaI detector approximately 0.6 to 0.9 m (2 or 3 ft) to either side of the direction of travel while maintaining the detector a few inches above ground level. The travel speed of the operator will be limited to no more than 0.22 m/sec (0.73 ft/sec). Operation of the NaI instrument will follow the procedures outlined in *SAM 935 Surveillance and Measurement System Instructions* (Berkley Nucleonics 1999). These instruments will be used primarily in those areas inaccessible by the GPRS. In addition, the instruments may be used as a secondary check of the GPRS results.

6.1.1.3 Laboratory X-ray Fluorescence Spectrometer.

Field screening samples will be collected at the ARA-01 and ARA-12 sites and analyzed for toxic metals on the COC list for each site identified in Table 2-1. The field screening samples will be transported to the laboratory where aliquots will be prepared and placed in the XRF analyzer for batch analysis. The XRF analyzer is capable of analyzing individual samples for several different metals, including arsenic, copper, mercury, selenium, and thallium, in a single measurement. The reported method detection limits of the laboratory XRF for the COCs are listed in Table 6-1. Although the XRF instrument detection limit is greater than the remedial action goal for mercury, analysis for mercury will be performed to identify hot spots at or above the instrument detection limits. The decision to continue excavation; however, will be based on the field screening sample results for Ag-108m, copper and selenium.

As can be seen from Table 6-1, the method detection for limits of the laboratory XRF are well below the remedial action goals for the Phase II remediation activities with the exception of mercury. Past sampling activities at the ARA-12 site show that mercury is co-located with the other COCs; therefore, field screening samples will be analyzed for copper and selenium to evaluate whether or not the remedial action objectives have been achieved. When the field screening samples show that the remedial action objectives have been met for copper and selenium, verification samples will be collected and analyzed for the full suite of COCs listed in Table 2-1.

6.1.2 Surface Soil Sampling

Verification samples will be collected from surface soils following excavation. For the radionuclide-contaminated sites, these samples will serve to validate the results obtained by the GPRS and the gamma field screening instrumentation. For the hazardous contaminated sites, the verification samples will be used to confirm that the site remediation goals have been achieved.

The surface soil samples will be collected following the procedures outlined in the current revision of TPR-61, Soil Sampling, formerly standard operating procedure 11.12 (INEEL 1996c). All surface samples to be analyzed for metals will be spatial composites of five subsamples collected from the four corners and the center of the 1 by 1-m (3.3 by 3.3 ft) plots. All surface samples to be analyzed for radionuclides will be spatial composites of ten subsamples collected at the center, and radial distances of 2, 4, and 10 m from the center, of the grid as shown in Figure 6-1. This configuration will provide a more representative sample to compare with the ISO-CART measurements. The samples will be collected between 0 to 7.6 cm (0 to 3 in.) in depth using a decontaminated trowel, spoon, or shovel. If soil conditions are not conducive to sampling by this method, either a thief sampler or hand auger may be used. Notation will be made in the sampling logbook at to which sampling method was employed.

Table 6-2. Laboratory XRF method detection limits for OU 5-12 nonradiological COCs.

Site	COC	XRF Method Detection Limit (mg/kg)	Remedial Action Goal (mg/kg)
ARA-01	Arsenic	0.6	10
	Selenium	0.6	2.2
	Thallium	1.7	4.3
ARA-12	Copper	0.9	220
	Mercury	1.7	0.5
	Selenium	0.6	2.2

In an attempt to make the in-situ measurement results more comparable to the radiological analytical sample data, the verification samples for radionuclides will be composite samples comprised of 10 equal volume subsamples taken at radial distances of 2, 4, and 10 m (6.5, 13, and 33 ft.) from the center of the sampling grid. These distances represent the effective field of view of the in-situ spectrometer as shown in Figure 6-1 below.

Each subsample will be sieved, using a stainless steel spoon, through a 2-mm (0.08 in.) mesh stainless steel screen into a disposable aluminum pan. This procedure will be conducted at each of the subsample points to remove all large rocks and debris. Following the collection of all subsamples, the soil in the aluminum pan will be thoroughly mixed with the stainless steel spoon. Sample containers will be filled from this composite. Sample material left over will be returned to the sample grid from which it originated. Each sample container will be surveyed by RadCon personnel and labeled appropriately if radiation readings exceed 100 counts above background.

Decontamination of sampling equipment will be performed as per TPR-52, Field Decontamination of Sampling Equipment, formerly SOP 11.5 (INEEL 1996d) with the exception that isopropanol will not be used at ARA-01, ARA-12, and ARA-23 given that organic constituents are not a concern at the contaminated soil sites.

6.1.3 Shipping Screening

Following sample collection, all samples will be surveyed for external contamination and field screened for radiation levels. All samples destined for off-Site laboratory analysis may be submitted to the Radiation Measurements Laboratory located at the Test Reactor Area at the INEEL for a 20-minute gamma screen prior to shipment. The FTL or RadCon technician may request shipping screens of specific samples from those sites where the radionuclide contamination is fairly well characterized or nonexistent. Gamma screening can be done using the same sample as that obtained for the gamma spectroscopic analysis, if such a sample is collected and is in the proper container.

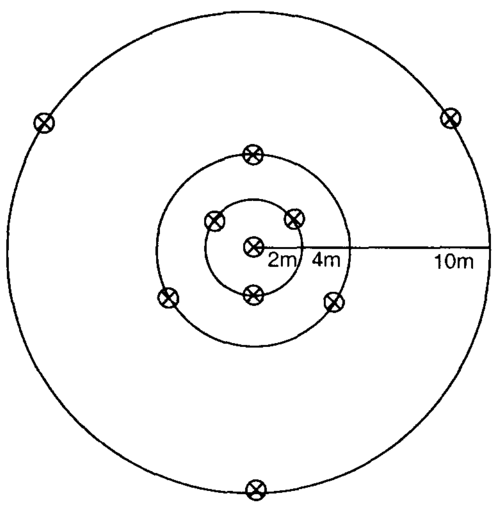

Figure 6-1. Composite sample plan for radiological samples.

6.2 Handling and Disposition of Remediation Waste

Remediation waste will be generated during the sampling activities as described herein. Wastes generated at all sites (ARA-01, ARA-12, and ARA-23) will be considered low level radioactive nonhazardous and not characteristic for any Resource Conservation Recovery Act (RCRA) constituents. The disposition and handling of waste for this project will be consistent with WGS and internal company procedures. Samples will be handled in accordance with MCP-2864, Sample Management (INEEL 1999f). All waste streams generated from the sampling activity will be characterized in accordance with MCP-444, Characterization Requirements for Solid and Hazardous Waste (INEEL 1999g), and will be handled, stored, and disposed accordingly.

Waste will be generated as a result of the sampling activities conducted during this project. Wastes expected to be generated during the sampling include the following:

- Personal protective equipment
- Unused/unaltered sample material
- Analytical residues
- Sample containers
- Miscellaneous wastes
- Contaminated equipment.

Depending upon the sampling site, wastes may be considered low level. As sampling continues, additional waste streams may be identified. All new waste streams projected, as well as those identified above, are required to have the waste identified and characterized. A hazardous waste determination will be completed for all waste generated during the OU 5-12 Phase II remedial action.

The wastes associated with the sampling activities will be managed in a manner that complies with the established ARARs, protects human health and the environment, and achieves minimization of remediation waste to the extent possible. The ARARs applicable to the storage of wastes are defined in accordance with the *Final Record of Decision Power Burst Facility and Auxiliary Reactor Area, Operable Unit 5-12* (DOE-ID 2000b). The basic provisions of the ARARs provide for appropriate waste containerization and compliant storage of the remediation wastes for an interim storage period. Protection of human health and the environment is achieved through implementation of the ARARs and through implementation of the waste management approach described herein.

6.2.1 Waste Minimization

Waste minimization techniques will be incorporated into planning and daily work practices to improve worker safety and efficiency. In addition, such techniques will aid in reducing the project environmental and financial liability. Specific waste minimization practices to be implemented during the project will include but not be limited to the following:

- Excluding materials that could become hazardous wastes in the decontamination process (if any)
- Controlling transfer between clean and contaminated zones

- Designing containment such that contamination spread is minimized
- Collecting all samples necessary at one time, such that additional wastes are not generated due to resampling.

The *U.S. Department of Energy Idaho Operations Office Idaho National Engineering and Environmental Laboratory Pollution Prevention Plan* (DOE-ID 1997b) addresses the efforts to be expended and the reports required to track waste generated by projects. This plan directs that the volume of waste generated by INEEL operations will be reduced as much as possible.

Industrial wastes do not require segregation by type; therefore, containers will be identified as industrial waste and maintained outside the controlled area for separate collection. Contaminated waste has the potential to be low level. This waste will require segregation as either incinerable (e.g., wipes, PPE) or nonincinerable (e.g., concrete), in anticipation of subsequent waste management. Containers for collection of contaminated waste will be clearly labeled to identify waste type and will be maintained inside the controlled area as defined in the project HASP until removal for subsequent management.

6.2.2 Laboratory Samples

All laboratory and sample waste is managed in accordance with the SMO master task agreements, as part of the contract for the subcontracted laboratory. The laboratory will dispose of any unused sample material. The laboratories are responsible for any waste generated as a result of analyzing the samples. In the event that unused sample material must be returned from the laboratory, only the unused, unaltered samples in the original sample containers will be accepted from the laboratory. These samples will be returned to the waste stream from which they originated. If the laboratory must return altered sample material (e.g., analytical residue), the laboratory will specifically define the types of chemical additives used in the analytical process and assist in making a hazardous waste determination. This information will be provided to the project FTL and environmental compliance coordinator. Management of this waste will also require separation from the other unaltered samples being returned.

6.2.3 Packaging and Labeling

Containers used to store and transport hazardous waste must meet the requirements of 40 CFR 264, Subpart I. The *Idaho National Engineering and Environmental Laboratory Reusable Property, Recyclable Materials, and Waste Acceptance Criteria* (DOE-ID 1998), hereinafter referred to as the reusable property, recyclable materials, and waste acceptance criteria (RRWAC), contains additional details concerning packaging and container conditions. Appropriate containers for RCRA waste include 208-L (55-gal) drums and other suitable containers that meet the DOT regulations on packaging (49 CFR 171, 173, 178, and 179) or RRWAC Sections 4.4, 4.5, and 4.6. Wooden boxes 1.2 × 1.2 × 2.4 m (4 × 4 × 8 ft) and 0.6 × 1.2 × 2.4 m (2 × 4 × 8 ft) may be used for sizable waste (e.g., piping, concrete), as well as soils. WGS will be consulted to ensure the packaging is acceptable to the receiving facility.

Waste containers will be labeled with standard hazardous waste labels. The following information will be included on the labels:

- Unique bar code serial number
- Name of generating facility (i.e., OU 7-06)
- Phone number of generator contact

- Listed or characteristic waste code(s)
- Waste package gross weight
- Maximum radiation level on contact and at 1 m (3 ft) in air
- Waste stream or material identification number as assigned by the receiving facility
- Prior to shipping, other labels and markings as required by 49 CFR 172, Subparts D and E.

Any of the above information that is not known when the waste is labeled may be added when the information is known.

The unique bar code serial number is used for tracking and consists of a five-digit number followed by a single alpha designator. The alpha designator indicates which facility generated the bar code. Presently, only WROC generates the bar codes and their alpha designator is "K." These bar codes will be furnished by WROC in lots of 50. A new bar code will be affixed to each container when waste is first placed in the container.

Any waste shipped off the INEEL from WAG 5 must be labeled in accordance with applicable DOT labels and markings (49 CFR 172). Additionally, waste labels must be visible, legibly printed or stenciled, and placed so that a full set of labels and markings are visible. See RRWAC (DOE-ID 1998) Section 4.4, 4.5, or 4.6 for additional labeling information.

6.2.4 Storage and Inspection

Wastes will be stored in the CERCLA waste storage unit (CWSU), PBF-ARA-1-CARGO-A, already established at ARA-I. Wastes stored in the CWSU will be stored in compliance with the *CERCLA Waste Storage Area Plan for PBF-ARA-1-CARGO-A* (INEEL 1999h). This plan will be modified as necessary to accommodate wastes proposed for storage in the CWSU. If required due to space limitations, a new CERCLA storage area (CSA) may need to be established as the remedial action progresses. Determination of the CSA location will be coordinated with and approved by the appropriate ARA or PBF personnel. Wastes placed in wooden storage boxes (1.2 × 1.2 × 2.4 m [4 × 4 × 8 ft] and 0.6 × 1.2 × 2.4 m [2 × 4 × 8 ft]), or other suitable containers, will be stored outside in a roped off area and also maintained as a CSA. Waste segregated as low-level radioactive only (e.g., soils, PPE, wipes, etc.) will be stored in a radioactive materials area near the CSA. The radioactive materials area will be established at the same time as the CSA.

To meet the substantive requirements of 40 CFR 264, Subpart I, the RCRA ARARs inspection of the CWSU and CSA will be conducted as part of the weekly waste container inspection. The purposes of the weekly container inspection are to look for containers that are leaking to look for containers that are deteriorating due to corrosion or other factors, to ensure that the containment system has not deteriorated due to corrosion, and to verify labels are in place and legible. Inspections of the containers and the CSA are conducted to meet the guidance contained in MCP-3475, Temporary Storage of CERCLA-Generated Waste at the INEEL (INEEL 1999i). The inspections will be documented on a weekly inspection form when completed. The checklists used to guide the inspection will be maintained in the CSA.

6.2.5 Personal Protective Equipment

The PPE requiring disposal may include, but is not limited to gloves, respirator cartridges, shoe covers, and coveralls. The PPE will be disposed in accordance with the requirements set forth in the RRWAC (DOE-ID 1998).

6.2.6 Hazardous Waste Determinations

All wastes generated will be characterized as required by 40 CFR 262.11. Hazardous waste determinations will be prepared for all waste streams as per the requirements set forth in MCP-62, Waste Generator Services—Low level Waste Management (INEEL 1999j). Completed hazardous waste determinations will be maintained for all waste streams as part of the project file held by WGS. Additionally, the excavated soils will require characterization to verify that they meet the WAC of the disposal facility. The hazardous waste determinations may use two approaches to determine whether a waste is characteristic and meets the disposal facility WAC:

1. Process knowledge may be used if there is sufficient existing information to characterize the waste. Process knowledge may include direct knowledge of the source of the contamination and/or existing validated analytical data.

2. Analysis of representative samples of the waste stream may be performed by either specialized RCRA protocols or standard protocols for sampling and laboratory analysis that are not specialized RCRA methods and other equivalent regulatory approved methods. Additionally, process knowledge and previous sampling activities may influence the amount of sampling and analysis required in order to perform characterization. It is anticipated that additional sampling will not be required by ICDF WAC.

Land disposal restrictions for hazardous wastes are addressed in 40 CFR 268. The INEEL specific requirements for treatment, storage, and disposal are addressed in the RRWAC (DOE-ID 1998). After the hazardous waste determinations are completed, the INEEL Interim Waste Tracking System profile number is assigned and the appropriate information entered into the tracking system.

6.2.7 Waste Disposition

At the conclusion of the investigations, or when deemed necessary, industrial waste will be dispositioned to the INEEL landfill, following the protocols and completing the forms identified by the RRWAC (DOE-ID 1998). When sufficient quantities of waste have been accumulated to ship to one of the INEEL waste management units or off the INEEL to a commercial waste management facility, WGS will be contacted and the appropriate forms will be completed and submitted for approval, as required. The waste generator interface will provide assistance in packaging and transportation of the waste.

All low-level radioactive and mixed wastes will be handled and disposed in accordance with MCP-1144, Preparing and Packaging Waste for Collection, (INEEL 1999k), and with the requirements set forth in the RRWAC (DOE-ID 1998). Care should be taken to ensure that all boxes used to store waste or sampling equipment are in a "like-new" condition. Following completion of sampling, the individual waste streams destined for disposal at the RWMC or WROC will be approved and prepared for disposal in accordance with the requirements of the RRWAC (DOE-ID 1998).

Management of contaminated wastes, generated at a subcontract laboratory during conductance of analytical testing, will be the responsibility of the subcontract laboratory. However, overall management of the samples must be in accordance with the requirements of MCP-2864, Sample Management (INEEL

1999f). Specifically, the MCP requires that the facility ES&H manager provide written approval prior to return of any media and that written documentation of sample disposition be developed and maintained. To initiate the return of these wastes to the INEEL, the subcontract laboratory will notify Bechtel BWXT Idaho, LLC (BBWI) in the form of a written report identifying the known volume and characteristics of each waste type, including shipping and packaging details. Final authorization for the return of wastes will be provided in writing, from BBWI to the subcontract laboratory. In the event that laboratory wastes are returned, WGS will be contacted and they will determine the disposition of those wastes.

6.2.8 Record Keeping and Reporting

Records and reports related to waste management are required to be maintained as indicated by MCP-3475, "Temporary Storage of CERCLA-Generated Waste at the INEEL" (INEEL 1999i). Some of these may be completed by others, but must be available either at the ARA sites or with the WAG 5 project files. These records will include, but not be limited to, the following:

- Hazardous waste determinations, characterization information, and statements of process knowledge (by others)
- CWSU and CSA inspection reports and log-in, log-out history
- Training records
- Documentation with respect to all spills.

6.3 Project-Specific Waste Streams

Several distinct waste stream types anticipated to be generated during this project have been identified. Some of these waste types will be clean, but many could be contaminated with radionuclides. Subsequent to generation, any or all of the waste may be reclassified; therefore, the intended waste management strategies for each are outlined in Sections 6.3.1 through 6.3.6. These sections describe the expected sampling wastes that will require compliant storage and/or disposal, including the intended management strategy from the time of generation until final disposition. Field and laboratory personnel will be responsible for segregating wastes. The anticipated quantities have also been approximated; however, they are considered a rough order-of-magnitude because, in some cases, the type of contamination present cannot be determined prior to sampling and analysis. Estimated waste volumes are based on historical sampling activities conducted in support of other CERCLA actions conducted at the INEEL.

6.3.1 Personal Protective Equipment

The PPE in the form of coveralls, leather and rubber gloves, shoe covers or boots, and other anti-contamination clothing may be generated during the sampling activities. The anticipated quantities of PPE to be generated and requiring disposal as a result of the sampling activities for each of the sites are as follows:

- ARA-01: 0.76 m^3 (1 yd^3) classified as low-level radiological or conditional industrial
- ARA-12: 0.76 m^3 (1 yd^3) classified as low-level radiological or conditional industrial
- ARA-23: 3.8 m^3 (5 yd^3) classified as low-level radiological or conditional industrial.

6.3.2 Unused/Unaltered Sample Material

Unused/unaltered sample material will be generated from the sampling activities in the form of soils not required for sampling and analysis. Generally, the analytical laboratory will be responsible for disposal of the unused/unaltered sample material. In those cases where samples must be returned from the laboratory, this excess material will be managed in accordance with MCP-3002, Managing Contaminated Soils (INEEL 2000c). All unused/unaltered sample material received by the INEEL for disposal will be returned to the point of origin whenever possible. Conditions that may preclude the return of soil to the original sampling location include, but are not limited to:

- Soil layer may have been excavated
- Backfill material may have been placed over the sample location
- Analytical results show that the sample material contains contaminants in excess of the remedial action goals.

If conditions preclude the return of unused/unaltered sample material to the point of origin, then the sample material will require disposal at an approved facility such as the ICDF.

6.3.3 Analytical Residues

Analytical residues will be generated from the sample analytical activities conducted by subcontracted and/or on-Site laboratories. Although the laboratories are required to dispose of analytical residues under terms of the subcontract, the potential does exist for return of analytical residues. The anticipated quantity of analytical residues to be generated and requiring disposal as a result of the field sampling activities are 0.76 m^3 (1 yd^3), classified as low-level radioactive waste.

6.3.4 Sample Containers

Sample containers will become a waste stream following analyses. The sample containers will be wiped clean, visually, and surveyed by an RCT. In the event that the sample containers are classified as low-level radioactive waste, they will be disposed at the RWMC or approved off-Site facility; otherwise, the sample containers will be disposed of as conditional industrial waste at the CFA landfill. The anticipated quantities of sample containers to be generated and requiring disposal as a result of the field sampling activities are 0.76 m^3 (1 yd^3), classified based on RCT survey results.

6.3.5 Miscellaneous Wastes

Miscellaneous wastes such as trash, labels, rags, wipes, and other miscellaneous debris may be generated during the field sampling activities. Clean miscellaneous waste will be removed to the CFA landfill. In the event that miscellaneous waste is classified as low-level radioactive waste, it will be disposed at the RWMC Subsurface Disposal Area. The anticipated quantities of miscellaneous wastes to be generated and requiring disposal as a result of the field sampling activities are 1.53 m^3 (2 yd^3), classified based on RCT survey results.

6.3.6 Contaminated Sampling Equipment

Contaminated equipment will become a waste stream in the event that it cannot be decontaminated, or reused for another project and disposal is required. Contaminated sampling equipment will be expected to be decontaminated to meet RadCon release requirements, and may include hand augers, spoons, pans, and screens.

7. DOCUMENTATION MANAGEMENT AND SAMPLE CONTROL

Section 7.1 summarizes document management and sample control. Documentation includes field logbooks used to record field data and sampling procedures. Section 7.2 outlines the sample handling and discusses chain-of-custody and radioactivity screening for shipment to the analytical laboratory. The analytical results from this sampling effort will be documented in the semi-annual operating/shutdown cycle reports.

7.1 Documentation

The CC and/or FTL will be responsible for controlling and maintaining all field documents and records and for ensuring that all required documents will be submitted to the ER Administrative Records and Document Control. All entries will be made in permanent ink. All errors will be corrected by drawing a single line through the error and entering the correct information. All corrections will be initialed and dated.

7.1.1 Sample Container Labels

Waterproof, gummed labels generated from the SAP database will display information such as the sample ID number, the name of the project, sample location, and analysis type. In the field, labels will be completed and placed on the containers before collecting the sample. Information concerning sample date, time, preservative used, field measurements of hazards, and the sampler's initials will be filled out during field sampling.

7.1.2 Field Guidance Forms

Field guidance forms, provided for each sample location, will be generated from the SAP database, to ensure unique sample numbers. Used to facilitate sample container documentation and organization of field activities, these forms contain information regarding the following:

- Media
- Sample ID numbers
- Sample location
- Aliquot ID
- Analysis type
- Container size and type
- Sample preservation.

7.1.3 Field Logbooks

In accordance with Administrative Records and Document Control format, field logbooks will be used to record information necessary to interpret the analytical data. All field logbooks will be controlled and managed according to MCP-231, Logbooks (INEEL 1998b).

7.1.3.1 Sample Logbooks. Sample logbooks will be used by the field teams. Each sample logbook will contain the following kinds of information:

- Physical measurements (if applicable)
- All QC samples
- Sample date, time, and location
- Shipping information (e.g., shipping dates, cooler ID number, destination, contaminant of concern number, name of shipper).

7.1.3.2 Field Team Leader's Daily Logbook. An operational logbook maintained by the FTL will contain a daily summary:

- All the project field activities
- Problems encountered
- Visitor log
- List of site contacts.

This logbook will be signed and dated at the end of each day's sampling activities.

7.1.3.3 Field Instrument Calibration/Standardization Logbook. A logbook containing records of calibration data will be maintained for each piece of equipment requiring periodic calibration or standardization. This logbook will contain logsheets to record the date, time, method of calibration, and instrument ID number.

7.2 Sample Handling

Analytical samples for laboratory analyses will be collected in precleaned containers and packaged according to American Society for Testing and Materials or EPA-recommended procedures. The QA samples will be included to satisfy the QA requirements for the field operation as outlined in the QAPjP (DOE-ID 2000a). Only qualified (SMO-approved) analytical and testing laboratories will analyze these samples.

7.2.1 Sample Preservation

Preservation of water samples will be performed immediately upon sample collection. If required for preservation, acid may be added to the bottles prior to sampling. For samples requiring controlled temperatures of 4°C (39°F) for preservation, the temperature will be checked periodically prior to shipment to certify adequate preservation. Ice chests (coolers) containing frozen reusable ice will be used to chill the samples, if required, in the field after sample collection.

7.2.2 Chain-of-Custody Procedures

The chain-of-custody procedures will be followed per MCP-244, Chain-of-Custody, Sample Handling, and Packaging for CERCLA Activities (INEEL 1999l), and the QAPjP (DOE-ID 2000a). Sample bottles will be stored in a secured area accessible only to the field team members.

7.2.3 Transportation of Samples

Samples will be shipped in accordance with the regulations issued by the DOT (49 CFR Parts 171 through 178) and EPA sample handling, packaging, and shipping methods (40 CFR 262 Subpart C and 40 CFR 263). All samples will be packaged in accordance with the requirements set forth in MCP-244, Chain-of-Custody, Sample Handling, and Packaging for CERCLA Activities (INEEL 1999l).

7.2.3.1 Custody Seals. Custody seals will be placed on all shipping containers in such a way as to ensure that sample integrity is not compromised by tampering or unauthorized opening. Clear plastic tape will be placed over the seals to ensure that the seals are not damaged during shipment.

7.2.3.2 On-Site and Off-Site Shipping. An on-Site shipment is any transfer of material within the perimeter of the INEEL. Site-specific requirements for transporting of samples within Site boundaries and those required by the shipping/receiving department will be followed. Shipment within the INEEL boundaries will conform to DOT requirements, as stated in 49 CFR. All shipments will be coordinated with WGS, as necessary, and conform to the applicable packaging and transportation MCPs. RadCon personnel will screen all samples to be removed from the RWMC for radiological contaminants prior to shipment.

7.3 Document Revision Requests

Revisions to this document will follow the requirements set forth in MCP-230, Environmental Restoration Document Control Center Interface (INEEL 1996e).

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Appendix A

Sampling and Analysis Tables

Plan Table Number: OU5-12 PHASE II
SAP Number:
Date: 08/04/00 Plan Table Revision: 0.0

SAMPLING AND ANALYSIS PLAN TABLE FOR CHEMICAL AND RADIOLOGICAL ANALYSIS

Project: PHASE 2 WAG 5 REMEDIAL ACTION ARA-01, ARA-12, AND ARA-23 Project Manager: FRANK L. WEBBER SMO Contact: DONNA R. KIRCHNER

SAMPLE DESCRIPTION						SAMPLE LOCATION				ENTER ANALYSIS TYPES (AT) AND QUANTITY REQUESTED																			
SAMPLING ACTIVITY	SAMPLE TYPE	MEDIA	COLL TYPE	SAMPLING METHOD	PLANNED DATE	AREA	LOCATION	TYPE OF LOCATION	DEPTH (ft)	AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20
										R4	XM																		
RA5100	REG	SOIL	COMP		05/01/03	ARA-01	LOCATION #1	CONFIRMATION	0-0.5		1																		
RA5101	REG	SOIL	COMP		05/01/03	ARA-01	LOCATION #2	CONFIRMATION	0-0.5		1																		
RA5102	REG	SOIL	COMP		05/01/03	ARA-01	LOCATION #3	CONFIRMATION	0-0.5		1																		
RA5103	REG	SOIL	COMP		05/01/03	ARA-01	LOCATION #4	CONFIRMATION	0-0.5		1																		
RA5104	REG	SOIL	COMP		05/01/03	ARA-01	LOCATION #5	CONFIRMATION	0-0.5		1																		
RA5105	REG	SOIL	COMP		05/01/03	ARA-01	LOCATION #6	CONFIRMATION	0-0.5		1																		
RA5106	REG	SOIL	COMP		05/01/03	ARA-01	LOCATION #7	CONFIRMATION	0-0.5		1																		
RA5107	REG	SOIL	COMP		05/01/03	ARA-01	LOCATION #8	CONFIRMATION	0-0.5		1																		
RA5108	REG	SOIL	COMP		05/01/03	ARA-01	LOCATION #9	CONFIRMATION	0-0.5		1																		
RA5109	REG/QC	SOIL	COMP		05/01/03	ARA-01	LOCATION #10	CONFIRMATION	0-0.5		2																		
RA5110	REG	SOIL	COMP		05/01/03	ARA-12	LOCATION #1	CONFIRMATION	0-0.5	1	1																		
RA5111	REG	SOIL	COMP		05/01/03	ARA-12	LOCATION #2	CONFIRMATION	0-0.5	1	1																		
RA5112	REG	SOIL	COMP		05/01/03	ARA-12	LOCATION #3	CONFIRMATION	0-0.5	1	1																		
RA5113	REG	SOIL	COMP		05/01/03	ARA-12	LOCATION #4	CONFIRMATION	0-0.5	1	1																		
RA5114	REG	SOIL	COMP		05/01/03	ARA-12	LOCATION #5	CONFIRMATION	0-0.5	1	1																		

The sampling activity displayed on this table represents the first six characters of the sample identification number.
The complete sample identification number (10 characters) will appear on field guidance forms and sample labels.

AT1: Gamma Spectroscopy
AT2: Total Metals
AT3:
AT4:
AT5:
AT6:
AT7:
AT8:
AT9:
AT10:

AT11:
AT12:
AT13:
AT14:
AT15:
AT16:
AT17:
AT18:
AT19:
AT20:

COMMENTS

ARA-01 Total Metals = arsenic, selenium, and thallium

ARA-12 Total Metals = copper, mercury, and selenium

Plan Table Number: OU5-12 PHASE II
SAP Number:
Date: 08/04/00 Plan Table Revision: 0.0

SAMPLING AND ANALYSIS PLAN TABLE FOR CHEMICAL AND RADIOLOGICAL ANALYSIS

Project: PHASE 2 WAG 5 REMEDIAL ACTION ARA-01, ARA-12, AND ARA-23 Project Manager: FRANK L. WEBBER SMO Contact: DONNA R. KIRCHNER

SAMPLE DESCRIPTION						SAMPLE LOCATION				ENTER ANALYSIS TYPES (AT) AND QUANTITY REQUESTED																			
SAMPLING ACTIVITY	SAMPLE TYPE	MEDIA	COLL TYPE	SAMPLING METHOD	PLANNED DATE	AREA	LOCATION	TYPE OF LOCATION	DEPTH (ft)	AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20
										R4	XM																		
RA5115	REG	SOIL	COMP		05/01/03	ARA-12	LOCATION #6	CONFIRMATION	0-0.5	1	1																		
RA5116	REG	SOIL	COMP		05/01/03	ARA-12	LOCATION #7	CONFIRMATION	0-0.5	1	1																		
RA5117	REG	SOIL	COMP		05/01/03	ARA-12	LOCATION #8	CONFIRMATION	0-0.5	1	1																		
RA5118	REG	SOIL	COMP		05/01/03	ARA-12	LOCATION #9	CONFIRMATION	0-0.5	1	1																		
RA5119	REG/QC	SOIL	COMP		05/01/03	ARA-12	LOCATION #10	CONFIRMATION	0-0.5	2	2																		
RA5120	REG	SOIL	COMP		05/01/03	ARA-23	ARA-I #1	CONFIRMATION	0-0.5	1																			
RA5121	REG	SOIL	COMP		05/01/03	ARA-23	ARA-I #2	CONFIRMATION	0-0.5	1																			
RA5122	REG	SOIL	COMP		05/01/03	ARA-23	ARA-I #3	CONFIRMATION	0-0.5	1																			
RA5123	REG	SOIL	COMP		05/01/03	ARA-23	ARA-I #4	CONFIRMATION	0-0.5	1																			
RA5124	REG	SOIL	COMP		05/01/03	ARA-23	ARA-I #5	CONFIRMATION	0-0.5	1																			
RA5125	REG	SOIL	COMP		05/01/03	ARA-23	ARA-I #6	CONFIRMATION	0-0.5	1																			
RA5126	REG	SOIL	COMP		05/01/03	ARA-23	ARA-I #7	CONFIRMATION	0-0.5	1																			
RA5127	REG	SOIL	COMP		05/01/03	ARA-23	ARA-I #8	CONFIRMATION	0-0.5	1																			
RA5128	REG	SOIL	COMP		05/01/03	ARA-23	ARA-I #9	CONFIRMATION	0-0.5	1																			
RA5129	REG/QC	SOIL	COMP		05/01/03	ARA-23	ARA-I #10	CONFIRMATION	0-0.5	2																			

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AT1: Gamma Spectroscopy
AT2: Total Metals
AT3:
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AT11:
AT12:
AT13:
AT14:
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AT17:
AT18:
AT19:
AT20:

COMMENTS

ARA-01 Total Metals = arsenic, selenium, and thallium
ARA-12 Total Metals = copper, mercury, and selenium

Plan Table Number: OU5-12 PHASE II
SAP Number:
Date: 08/04/00 Plan Table Revision: 0.0

SAMPLING AND ANALYSIS PLAN TABLE FOR CHEMICAL AND RADIOLOGICAL ANALYSIS

Project: PHASE 2 WAG 5 REMEDIAL ACTION ARA-01, ARA-12, AND ARA-23 Project Manager: FRANK L. WEBBER SMO Contact: DONNA R. KIRCHNER

SAMPLE DESCRIPTION						SAMPLE LOCATION				ENTER ANALYSIS TYPES (AT) AND QUANTITY REQUESTED																			
SAMPLING ACTIVITY	SAMPLE TYPE	MEDIA	COLL TYPE	SAMPLING METHOD	PLANNED DATE	AREA	LOCATION	TYPE OF LOCATION	DEPTH (ft)	AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20
										R4	XM																		
RA5130	REG	SOIL	COMP		05/01/03	ARA-23	ARA-11 #1	CONFIRMATION	0-0.5	1																			
RA5131	REG	SOIL	COMP		05/01/03	ARA-23	ARA-11 #2	CONFIRMATION	0-0.5	1																			
RA5132	REG	SOIL	COMP		05/01/03	ARA-23	ARA-11 #3	CONFIRMATION	0-0.5	1																			
RA5133	REG	SOIL	COMP		05/01/03	ARA-23	ARA-11 #4	CONFIRMATION	0-0.5	1																			
RA5134	REG	SOIL	COMP		05/01/03	ARA-23	ARA-11 #5	CONFIRMATION	0-0.5	1																			
RA5135	REG	SOIL	COMP		05/01/03	ARA-23	ARA-11 #6	CONFIRMATION	0-0.5	1																			
RA5136	REG	SOIL	COMP		05/01/03	ARA-23	ARA-11 #7	CONFIRMATION	0-0.5	1																			
RA5137	REG	SOIL	COMP		05/01/03	ARA-23	ARA-11 #8	CONFIRMATION	0-0.5	1																			
RA5138	REG	SOIL	COMP		05/01/03	ARA-23	ARA-11 #9	CONFIRMATION	0-0.5	1																			
RA5139	REG/QC	SOIL	COMP		05/01/03	ARA-23	ARA-11 #10	CONFIRMATION	0-0.5	2																			
RA5140	REG	SOIL	COMP		05/01/03	ARA-23	HAUL ROAD #1	CONFIRMATION	0-0.5	1																			
RA5141	REG	SOIL	COMP		05/01/03	ARA-23	HAUL ROAD #2	CONFIRMATION	0-0.5	1																			
RA5142	REG	SOIL	COMP		05/01/03	ARA-23	HAUL ROAD #3	CONFIRMATION	0-0.5	1																			
RA5143	REG	SOIL	COMP		05/01/03	ARA-23	HAUL ROAD #4	CONFIRMATION	0-0.5	1																			
RA5144	REG	SOIL	COMP		05/01/03	ARA-23	HAUL ROAD #5	CONFIRMATION	0-0.5	1																			

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COMMENTS

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Plan Table Number: OU5-12 PHASE II
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Date: 08/04/00 Plan Table Revision: 0.0

SAMPLING AND ANALYSIS PLAN TABLE FOR CHEMICAL AND RADIOLOGICAL ANALYSIS

Project: PHASE 2 WAG 5 REMEDIAL ACTION ARA-01, ARA-12, AND ARA-23 Project Manager: FRANK L. WEBBER SMO Contact: DONNA R. KIRCHNER

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										R4	XM																		
RA5145	REG	SOIL	COMP		05/01/03	ARA-23	HAUL ROAD #6	CONFIRMATION	0-0.5	1																			
RA5146	REG	SOIL	COMP		05/01/03	ARA-23	HAUL ROAD #7	CONFIRMATION	0-0.5	1																			
RA5147	REG	SOIL	COMP		05/01/03	ARA-23	HAUL ROAD #8	CONFIRMATION	0-0.5	1																			
RA5148	REG	SOIL	COMP		05/01/03	ARA-23	HAUL ROAD #9	CONFIRMATION	0-0.5	1																			
RA5149	REG/QC	SOIL	COMP		05/01/03	ARA-23	HAUL ROAD #10	CONFIRMATION	0-0.5	2																			
RA5150	REG	SOIL	COMP		05/01/03	ARA-23	WASH DOWN #1	CONFIRMATION	0-0.5	1																			
RA5151	REG	SOIL	COMP		05/01/03	ARA-23	WASH DOWN #2	CONFIRMATION	0-0.5	1																			
RA5152	REG	SOIL	COMP		05/01/03	ARA-23	WASH DOWN #3	CONFIRMATION	0-0.5	1																			
RA5153	REG	SOIL	COMP		05/01/03	ARA-23	WASH DOWN #4	CONFIRMATION	0-0.5	1																			
RA5154	REG	SOIL	COMP		05/01/03	ARA-23	WASH DOWN #5	CONFIRMATION	0-0.5	1																			
RA5155	REG	SOIL	COMP		05/01/03	ARA-23	WASH DOWN #6	CONFIRMATION	0-0.5	1																			
RA5156	REG	SOIL	COMP		05/01/03	ARA-23	WASH DOWN #7	CONFIRMATION	0-0.5	1																			
RA5157	REG	SOIL	COMP		05/01/03	ARA-23	WASH DOWN #8	CONFIRMATION	0-0.5	1																			
RA5158	REG	SOIL	COMP		05/01/03	ARA-23	WASH DOWN #9	CONFIRMATION	0-0.5	1																			
RA5159	REG/QC	SOIL	COMP		05/01/03	ARA-23	WASH DOWN #10	CONFIRMATION	0-0.5	2																			

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AT19:
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COMMENTS

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Plan Table Number: OU5-12 PHASE II
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SAMPLING AND ANALYSIS PLAN TABLE FOR CHEMICAL AND RADIOLOGICAL ANALYSIS

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										R4	XM																		
RA5160	REG	SOIL	COMP		05/01/03	ARA-23	WINDBLOWN #1	CONFIRMATION	0-0.5	1																			
RA5161	REG	SOIL	COMP		05/01/03	ARA-23	WINDBLOWN #2	CONFIRMATION	0-0.5	1																			
RA5162	REG	SOIL	COMP		05/01/03	ARA-23	WINDBLOWN #3	CONFIRMATION	0-0.5	1																			
RA5163	REG	SOIL	COMP		05/01/03	ARA-23	WINDBLOWN #4	CONFIRMATION	0-0.5	1																			
RA5164	REG	SOIL	COMP		05/01/03	ARA-23	WINDBLOWN #5	CONFIRMATION	0-0.5	1																			
RA5165	REG	SOIL	COMP		05/01/03	ARA-23	WINDBLOWN #6	CONFIRMATION	0-0.5	1																			
RA5166	REG	SOIL	COMP		05/01/03	ARA-23	WINDBLOWN #7	CONFIRMATION	0-0.5	1																			
RA5167	REG	SOIL	COMP		05/01/03	ARA-23	WINDBLOWN #8	CONFIRMATION	0-0.5	1																			
RA5168	REG	SOIL	COMP		05/01/03	ARA-23	WINDBLOWN #9	CONFIRMATION	0-0.5	1																			
RA5169	REG/QC	SOIL	COMP		05/01/03	ARA-23	WINDBLOWN #10	CONFIRMATION	0-0.5	2																			
RA5170	QC	WATER	RNST		05/01/03	ARA-01	QC	RINSATE	N/A		1																		
RA5171	QC	WATER	RNST		05/01/03	ARA-12	QC	RINSATE	N/A	1	1																		
RA5172	QC	WATER	RNST		05/01/03	ARA-23	QC ARA-I	RINSATE	N/A	1																			
RA5173	QC	WATER	RNST		05/01/03	ARA-23	QC ARA-II	RINSATE	N/A	1																			
RA5174	QC	WATER	RNST		05/01/03	ARA-23	QC HAUL ROAD	RINSATE	N/A	1																			

The sampling activity displayed on this table represents the first six characters of the sample identification number.
The complete sample identification number (10 characters) will appear on field guidance forms and sample labels.

AT1: Gamma Spectroscopy
AT2: Total Metals
AT3:
AT4:
AT5:
AT6:
AT7:
AT8:
AT9:
AT10:

AT11:
AT12:
AT13:
AT14:
AT15:
AT16:
AT17:
AT18:
AT19:
AT20:

COMMENTS

ARA-01 Total Metals = arsenic, selenium, and thallium
ARA-12 Total Metals = copper, mercury, and selenium

Plan Table Number: OU5-12 PHASE II
SAP Number:
Date: 08/04/00 Plan Table Revision: 0.0

SAMPLING A ANALYSIS PLAN TABLE FOR CHEMICAL AND RADIOLOGICAL ANALYSIS

Project: PHASE 2 WAG 5 REMEDIAL ACTION ARA-01, ARA-12, AND ARA-23 Project Manager: FRANK L. WEBBER SMO Contact: DONNA R. KIRCHNER

SAMPLE DESCRIPTION						SAMPLE LOCATION				ENTER ANALYSIS TYPES (AT) AND QUANTITY REQUESTED																			
SAMPLING ACTIVITY	SAMPLE TYPE	MEDIA	COLL TYPE	SAMPLING METHOD	PLANNED DATE	AREA	LOCATION	TYPE OF LOCATION	DEPTH (ft)	AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20
										R4	XM																		
RA5175	QC	WATER	RNST		05/01/03	ARA-23	QC WASH DOWN	RINSATE	N/A	1																			
RA5176	QC	WATER	RNST		05/01/03	ARA-23	QC WINDBLOWN	RINSATE	N/A	1																			

The sampling activity displayed on this table represents the first six characters of the sample identification number.
The complete sample identification number (10 characters) will appear on field guidance forms and sample labels.

AT1: Gamma Spectroscopy
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AT10:

AT11:
AT12:
AT13:
AT14:
AT15:
AT16:
AT17:
AT18:
AT19:
AT20:

COMMENTS

ARA-01 Total Metals = arsenic, selenium, and thallium
ARA-12 Total Metals = copper, mercury, and selenium